The Electrical World.

Vol. XXXII. NEW YORK, AUGUST 13, 1898. No. 7.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY,

9 Murray Street, New York.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.
Western Office, 936 Monadnock Block, Chicago.
Philadelphia Office, 929 Chestnut Street.

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THE ELECTRICAL WORLD,

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THE CRITICAL LIMIT OF POWER.

There has always been quite a widely accepted idea that there is a limit of the power of generating stations above which—considerations of distribution entirely aside—it does not pay to increase the size, or in other words is as well to operate two stations of smaller size as the one of large size. Some four years ago this critical limit for generating stations was placed by one prominent writer at somewhere between 3000 and 5000 horse-power, and this was criticised by many as being too high a figure. Now that single generating units equal or exceed this power it is recognized as absurdly low for a station limit. With direct-current systems the limit of size is quickly determined by the power consumed in the district which can be covered at practical voltages. In traction work where the load is concentrated, as in some of the larger cities of this country, single stations of 8000, 10,000 or 12,000 horse-power are often built with feeder losses so great that multiple stations would undoubtedly be preferable, but the advantages of concentration are so much in evidence, and the power lost in the feeder system so little in evidence, that concentration is practiced where it should not be. By alternating systems, now that high voltages are becoming fashionable, distribution may be carried economically from a single center of generation over a district covering several hundred square miles, and in the more densely populated parts of this country stations might be loaded, having a capacity far beyond anything so far attempted. The question then arises at what point is it just as economical to operate two stations as one of the same aggregate capacity?

Taking up the various parts of the station one by one, there is as a rule no gain in the boilers after a station has reached a few thousand hp-capacity. The gain in large boilers over smaller ones is extremely slight, and as station size increases the boilers are not enlarged in size, but are increased in number. With the engines there is a continuing advantage, as the size increases, both in efficiency and weight per horse-power, and, as the largest sizes so far used for electrical generation purpose are greatly exceeded by sizes of a similar type used in marine practice, special experimental work is not as yet involved by increase in size, and the cost per horse-power continues to go down as the size increases. The design of electrical generators of the alternating type is now so well understood that untried sizes can be built with certainty of successful operation, but there is as a rule no economy in first cost per horse-power of unusual sizes, as the special designs and special construction machinery outweigh the saving in material and workmanship.

No matter how large the station, there is still some little gain per horse-power in the first cost, due to concentration, as it is cheaper to erect duplicate apparatus at one point than to construct the equivalent of the same at several points. But the greatest saving is undoubtedly in the operation of single large stations. Even if the size has become so great that the concentration allows no increase in the size of the generating units themselves, the duplication allows many little economies that would not pay with a smaller equipment. This is owing to the fact that the complexity of these little economies does not increase with their increased size, while the saving is directly proportional to the size. The single item of feed-water pumps serves as an example, for even in stations of a moderately large size the pumps are extremely wasteful of steam. But when the capacity of the plant becomes very great

multiple expansion flywheel pumps can be introduced, their economy overbalancing on account of their size the disadvantage of increased complexity.

Many other details, such as oil circulating equipment, coal and ash-handling machinery, mechanical draft, economizers, etc., are similarly affected. An example of this may be cited in the case of alternating current stations in the use of storage batteries. While this may not be advisable in small or moderate sized stations, owing to the complexity, the cost and the inefficiency of the rotary transformers needed therewith, undoubtedly there is a size of plant above which these factors would be more than outweighed by the advantages gained, since these advantages are directly proportional to the size of the plant, while the added complexity is no greater and the inefficiency and the cost per kilowatt are less. One crane, for another example, serves an engine-room containing ten generating units as well as one containing five. When the station reaches a certain size it pays to install a crane operated by power; the saving in manual labor with stations larger than that size being greater than the cost of power equipment. The larger the station also the greater is the differentiation of labor and in consequence the greater is the effectiveness of that labor.

As a rule the greater the centralization of the power generation the better is the load factor. In a lighting system the peak of the load does not occur simultaneously in residence and business districts. In a railroad system, pleasure resort lines may have their peak at one time and the lines serving business districts at another. Combined lighting, power distribution and traction systems gain still more by the improvement in load factor due to the combination of different loads.

Thus it appears that increase in size causes a continued increase in economy, so far as the station itself is concerned, which increase undoubtedly grows smaller and smaller as the size continues to increase, but never reaches zero, approaching that value, as the mathematicians would say, asymptotically. At a certain point dependent on the concentration of the load this gain is met by the disadvantage of long feeders, but with high tension alternating currents this point is not reached until the district is a very large one, sufficiently large in the case of large cities for stations of a power hitherto unheard of. For example there is no engineering reason (considerations of ownership aside) why one central station should not generate all the electrical energy utilized in the Greater New York and some little of the adjacent suburban district by current distributed at a voltage now quite common in that territory, namely, 5000 volts. The power of such a station would run up into the hundreds of thousands of horse-power with an economy that would stimulate a demand for its output enormously. With the rapidly expanding use of electric power for all purposes, and the continual process of consolidation of allied and rival interests, this highly centralized central station may not be far in the future.

SWITCH PILLARS.

In one detail of electric traction work the English have standardized a practice superior to anything in the same line in America. This practice is the use of what are known in England as switch pillars. They consist of cast-iron cases, generally placed above the ground, located near the sectional insulators of the trolley line and containing a group of switches by which any one of the various parts of the feeder and trolley system may be cut out if necessary. As a rule each pillar contains four switches by which the four lengths of overhead trolley wire running in the two directions on the up and down tracks may be connected or disconnected from a bus bar, and one or more switches by which the feeders passing that point may be tapped into the same bus. Obviously by opening the proper switches in adjacent pillars, which are generally about a half a mile apart, one section of the overhead trolley wire on one track may be opened in case of trouble without interfering with the current supplied to any other part of the system. If the feeders are looped into the pillars their sections may be similarly cut out.

In this country several practices in this detail are to be found. Some roads tie their whole overhead system together, depending on the ability of their generating stations to burn out grounds and thus prevent the latter from shutting down the whole system. Others insulate their various sections from each other absolutely at the sectional insulators, running separate feeders to each section, thus obtaining at the feeder panels of the power station switchboard absolute control of the current supplied to the separate sections of the line. While this is an advantage, it involves considerable disadvantages, as the feeders do not assist each other at times of unequally distributed loads as they do when the system is tied together. Some engineers favor the bridging of the sectional insulator by a connection brought through a box on the pole in which there may be a switch or fuse or both. In case there is a short circuit on any section, as soon as the circuit breaker supplying the feeder of that section from the switchboard opens, the current taken by the short circuit comes through the fuses and blows them, insulating the section and rendering its supply of power controllable by the station switchboard attendant. In case of fire or other trouble on account of which it may be desirable to take the power off from any section of the line this can be done by the switches at the sectional insulators and the feeder switches at the main switchboard. By this arrangement the feeders help each other out to a certain extent on unequally distributed loads, and in case of trouble current supplied to the sections may be controlled by the power station.

With large systems the drop of voltage in the feeders necessitates the use of the feeder and main principle whereby the line voltage even in the immediate neighborhod of the generating station is lower than the station voltage by an amount practically the same as at the distant terminals. This is accomplished by making no connection between the station bus bars and the trolley wires where they pass the station and by making the shorter feeders of smaller cross section than the longer ones so that the drop in the two on the average load shall be about the same. In smaller systems, however, this principle is departed from and all of the overhead copper, including the trolley wires and the so-called feeders, are simple mains, the trolley lines being connected direct to the bus bars at the station near which cars get full machine voltage which falls off due to the drop as they run from that point. In many such systems a group of feeders may be seen following the lines, each feeder being tapped into the trolley wires in its own district, with no cross connections between the feeders. In this case the economy of copper is very poor, owing to the fluctuating loads on the various sections and the fact that the feeders cannot to any considerable extent help each other, as they could if they were frequently cross connected. There may generally be seen in such systems a very marked difference between the cross section of the overhead copper leaving the station and that of the copper in the return circuits. This is not because of any assistance from ground returns or any difference between the calculated drop in the two sides, but because of the fact that the whole return circuit is cross connected and tied together, and the fluctuating loads at various points can mutually adjust themselves between many return lines while they are limited by the overhead system to their own individual feeders. In this respect the English system is superior to the American one, as by means of the switch pillars all the feeders and the trolley lines are cross connected, utilizing all copper in the most advantageous way for the conduction of current.

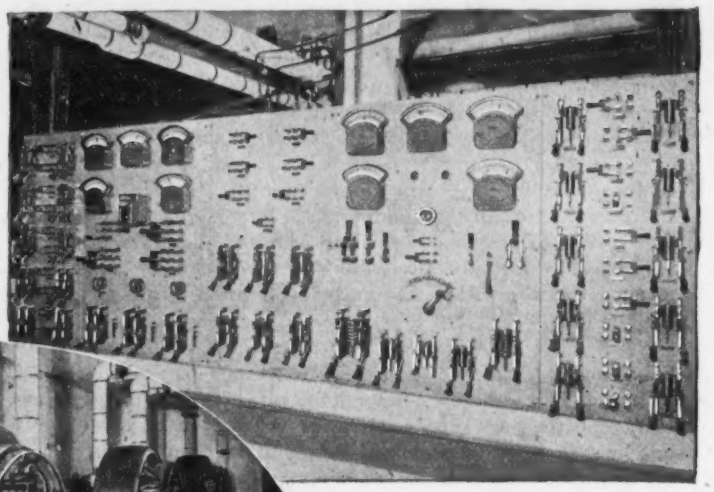
Some New Isolated Plants—II.

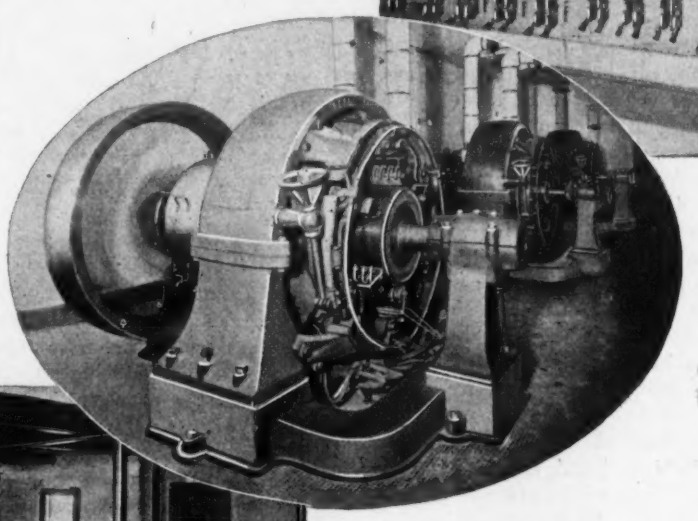
THE DUN BUILDING.

ONE of the most handsome office buildings recently constructed is that erected by R. G. Dun & Co. for general office purposes at the corner of Broadway and Reade Street, the whole building being planned on the principle that the best is none too good, regardless of expense.

The isolated plant of this building is of considerable size, owing to the expected lavish use of lights and the use of electric power for operating the elevators. Steam is supplied to it by two 300-hp Babcock & Wilcox boilers, through steam piping supported by hangers from the structure overhead, all of the piping being of steel with steel flanges welded on. The generating sets, shown in the accompanying illustration, are mounted on a single concrete pier or foundation, 3 feet deep, surmounted by capping stones 1 foot deep, the whole forming a platform under the Broadway sidewalk elevated slightly above the engine room floor. The machines are all wound for 245 volts, the building being wired on the two-wire system for 240-volt lamps.

To improve the economy and regulation of these generators and to enable the lights and power to be run from one generator without too great a fluctuation of the voltage, a storage battery has been installed consisting of 114 cells of chloride accumulators supplied by the Electric Storage Battery Company, Philadelphia, with a capacity of 140 amperes at a seven-hour discharge rate and a maximum emergency discharge rate of 600 amperes. This battery is connected with the generating system by a motor-driven differential booster, the motor and booster being mounted on a common bedplate, the whole constructed by the General Electric Company. The arrangement of the battery and booster circuits is such that the battery at night can be thrown straight across the bus bars to carry the whole load of lights and motors, while during the daytime, when the generators are running, the lighting system will be connected to them direct, and the motors, in parallel with the storage battery, will be connected to the generator or generators through the differential booster, the arrangement being such that the charging current or the current passing from the generator to the battery and its load will pass through the armature and series field of the boster, the series field tending to cut down the constant excitation of the shunt field. By this means the fluctuating demand which the elevators would exert on the generating system in spite of the steadying effect of the battery will be reduced, owing to the fact that the fluctuations will vary the booster e. m. f. in such a way as to cut themselves down, thus making the battery take up most of the variation of the load.





BATTERY ROOM, ROW OF GENERATORS AND SWITCHBOARD OF THE DUN BUILDING.

For further provision against any emergency a breakdown service from the Edison street mains is provided. This breakdown service will eventually be so connected that the whole plant can be run by it, although at present only the lighting feeders are arranged for supply from this source. The final arrangement is so planned that the Edison current will only reach the elevator load through the storage battery with the booster arranged to smooth out the fluctuations, as when charging from the generators, so that the demand on the central station will be a comparatively steady one, and an especially low rate is promised on account of this advantageous condition.

A rough idea of the economy attained by the use of this storage battery has already been afforded by a comparison of the amount of fuel consumed in a given time with and without the battery in service, other conditions remaining the same. It was found that without the storage battery in service about 33 per cent. more fuel was burned than when the battery was connected, in spite of the power obviously lost in the battery itself. This is to be explained by the improved steam economy under the steady load afforded by the battery and the fact that with the battery but one generator was needed, while without it two were required on account of high brief loads and the necessity of separating the motor and the lighting loads.

The switchboard is a remarkably handsome structure of Tennessee marble, divided into five panels, the extreme panels at the two ends being fitted with the switches and circuit breakers of the lighting feeders, the centre panel with those of the power feeders, the panel immediately to the left controlling the generators and to the right the storage battery and booster. Every circuit entering or leaving the board is equipped with an Ideal circuit breaker, and all lighting and power feeders are fused on separate panels behind the board. The board is fitted with two complete sets of triple-pole bus bars, on either of which the generators may be run separately or in multiple, but on one of which the storage battery will be customarily run alone. During the daytime the arrangement will be such as to carry the lighting feeders immediately from the generators, run singly or in multiple with each other, on one set of bus bars, and the motor system, consisting principally of screw type elevators, on the other set of bus bars, supplied by the storage battery, the booster being inserted between the two sets. By means of the switches on the board other combinations may be made, the generator being shut down at night and both lights and power being carried from the battery direct without a booster. The main generator switches are double-throw, one throw to each set of buses.

The power feeder switches supplying the elevators are also double-throw between the two sets of buses and the lighting feeder switches are double-throw, one side going to the generator buses and the other to the Edison breakdown service. All bus bars, studs and main connections, as well as the contacts between the same, are proportioned for a current density at full load of 750 amperes per square inch, the contacts being all sweated.

An admirable point of the system is the location of the storage battery, which is placed on the roof beneath a special light steel frame iron-sheathed superstructure. By this arrangement there is not the slightest danger of corrosion from the battery fumes reaching the apparatus in and about the engine room; there is not the slightest difficulty in obtaining ventilation, and there is no danger of the fumes becoming noticeable in the building. There is, of course, plenty of room on the roof and the battery can, therefore, be a single tier in height, as shown in the accompanying illustration. The regular arrangement allows the utmost simplicity in connection from cell to cell. The steel and iron work in the battery room is painted with an asphaltic paint and the walls are finished in rough mortar. The battery cells contain fifteen plates each in wooden boxes, in each of which there is room for four more plates if necessary. The battery is tied to the switchboard by two 375,000-cm cables on each pole, these cables running with all the other cables of the lighting and communication systems in a single vertical runway through the building. An interesting detail of this runway is the arrangement of the iron-armored conduits, the lengths of which are let into holes in steel plates mounted on the steel structure at each floor, the fastening being effected by nuts threaded on the conduits.

Besides the six Sprague screw type elevators there are one ash hoist, one sidewalk elevator and one 72-inch fan, all motor driven, as well as one Quimby screw pump, which is run at night from the storage battery to supply whatever water is used throughout the building, the water pressure being maintained by pressure drums in the basement with pneumatic cushion, a small air pump maintaining this by an occasional run. The building also contains a 10-ton refrigerating plant, an interesting detail of which is the disposal of the circulating water which carries off the heat of the condensed ammonia. This water, of about 100° temperature, is ordinarily piped to the sewer, the water, costing $1 per 1000 cubic feet, as well as the heat, being entirely lost. In this building, however, the water is piped to the kitchen of a large restaurant above, where it will be largely used in dish-washing machines, etc., the kitchen being, therefore, supplied with water at four temperatures, ice cold, ordinary, about 100° and about boiling point.

The consulting engineer of this plant was Mr. R. P. Bolton, the constructing engineers of the switchboard and wiring being P. M. Mowrey & Co. The engineer in charge of the plant is Mr. G. M. Dunscomb.

Convention of the Ohio Electric Light Association.

The fourth annual meeting of the Ohio Electric Light Association will be held at the West House, Sandusky, Ohio, on August 18 and 19. The following papers will be read: "Positive and Negative Economies in Small Central Stations," by E. P. Roberts; "Some Suggestions Relative to Determining the Cost of Electrical Supply," by M. E. Turner; "The Meter's Relation to the Dividend." by Caryl D. Haskins; "Comparative Commercial Qualities of Old and Modern Transformers as Applied to an Exchange," by J. H. Perkins; "Long Distance Transmission of Power," by E. J. Berg.

The following queries from the question box will be brought up for discussion:

1. What are the advantages and disadvantages of inclosed arc lamps for outside lighting?
2. Can the candle power of arc lamps be accurately determined by the use of a portable photometer?
3. In what way can competition of the gasoline incandescent burner be most successfully met?
4. Is it advisable for a plant to change from 15,000 cycles alternating single-phase to 7200 two-phase if no question of motor business is concerned?
5. What are the types and makes of gas engines in use in the smaller plants of the association; the time of their installation and their condition at the present time?

The secretary of the association is Mr. Samuel Scovil, with offices at the Cuyahoga, Cleveland.

The Sayers Winding.

The American patent No. 607,593, issued to Mr. W. B. Sayers on July 19, 1898, for a modification of the Sayers winding, adds no little to the ingenious combinations already proposed by Mr. Sayers for the reduction of commutator sparking and for the automatic internal provision of an e. m. f. in the short-circuited sections proportional to the load for properly reversing the currents while the adjacent commutator segments are under the brushes. To make clear the working of this latest modification it may be well to describe the earlier plans proposed by Mr. Sayers, the following information and figures being taken from his earlier American patents, the first of which was No. 516,553, issued March 13, 1894.

The general plan of the Sayers winding contemplates the insertion between the commutator segments and the junctions of the armature coils, which are in ordinary windings connected directly together, of auxiliary coils or turns, so arranged as to cut the field at the instant of commutation, and of sufficient strength to reverse the currents within themselves, the field in which they lie being automatically proportioned by the armature reaction to the armature load. Each of these turns is, of course, active only at the instant when its segment is under the brush, being on open circuit the rest of the time. The first patent mentioned above describes these auxiliary turns or coils, *B*, Fig. 1, as wound upon a ring armature in a direction the reverse of that of the main windings, *A*, and with a backward lead in the case of a generator—that is, the commutator windings are set off to one side of the junctions, *D*, with which they connect in such a way as to follow the latter as the armature revolves. With this reverse winding the fringe of the field used for commutation should, of course, be in the reverse direction from that normally used, and to obtain this the brushes must be shifted in the opposite direction from that customary, or, in the case of generators, the lead should be backward. The auxiliary winding, if wound, as described, further back than the coils to which it is connected, will be, at the instant of commutation, under a stronger part of the field horn than they will, and if of the same number of turns as the latter it will thereby give an e. m. f. sufficiently greater than that in the main coils to reverse the current. It will be readily seen that on account of this backward lead the commutation will be brought under the horn into which the field is concentrated under heavy load by the armature reaction, and the action on the auxiliary coils will therefore be strengthened as the load increases, instead of weakened, as in ordinary windings, the reversing action in the short-circuited coils being thereby rendered more or less proportional to the load, instead of the reverse.

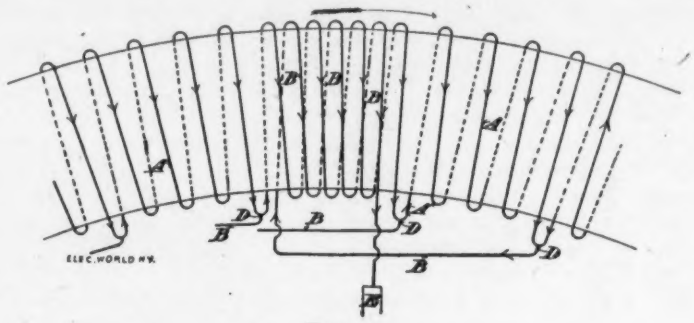


Fig. 1.

On account, also, of the reversed lead the armature reaction tends to assist instead of to oppose the field magnetization.

This arrangement is obviously fitted for running the armature in one direction only, since the auxiliary coils are wound to one side of the junctions of the main coils to which they are attached. To run the same machine as a motor, the armature distortion being reversed and the crowding of the lines of force therefore being thrown over to the other horns, the direction of rotation must be reversed. To provide an arrangement capable of running in either direction and either as a motor or a dynamo, a plan is outlined in patent No. 524,119, issued August 7, 1894. This patent describes a multipolar drum winding of either the lap or wave type, each commutator coil, B^1, B^2, Fig. 2, spanning only a small part, say one-sixth, of the pole angle, embracing and preferably adjacent to the slots carrying the two armature coils, A^1 and A^2, with whose junction, A^3, it connects. Thus when the machine is running in

either direction as a generator, one side of the commutator coil follows the armature coils, with which it connects and is under the crowded horn of the pole piece, after its other side and also its armature coils have left it. It, therefore, effects the reversal, its reversing tendency being more or less proportioned to the armature distortion, and hence to the load. When the machine is running as a motor, the other side of the commutating coil is active, as it is ahead of its armature coils and gets under the crowded leading horn before they do, its complementary side being inoperative and the leading side effecting the commutating reversal. Va-

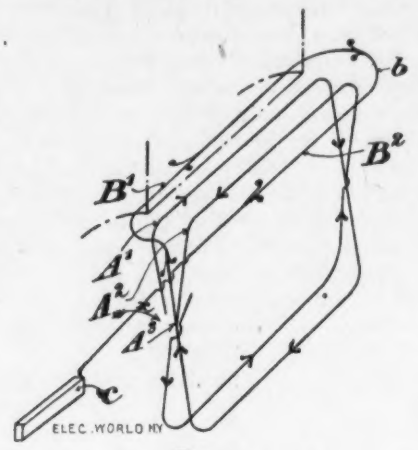


FIG. 2.

rious modifications are described in this patent, consisting of peculiarly shaped pole pieces, metallic bridges, etc., the general principle remaining the same.

In the patent just issued by the American office, No. 607,593, a further modification is effected, consisting, as shown in Figs. 3 and 4, of iron frames, surrounding each field pole outside of its exciting winding, the sides of the frames running axially along the armature, being brought down and arranged as small pole pieces, *p p*, close to the face of the armature. The purpose of this device is to provide an auxiliary field through the armature core and completing itself through these frames, this auxiliary field being entirely independent of the main field excitation, its magnetomotive force being solely due to the armature cross magnetization and being, hence, proportional to the armature load up to saturation of the circuit. The brushes should be so set that the commutator

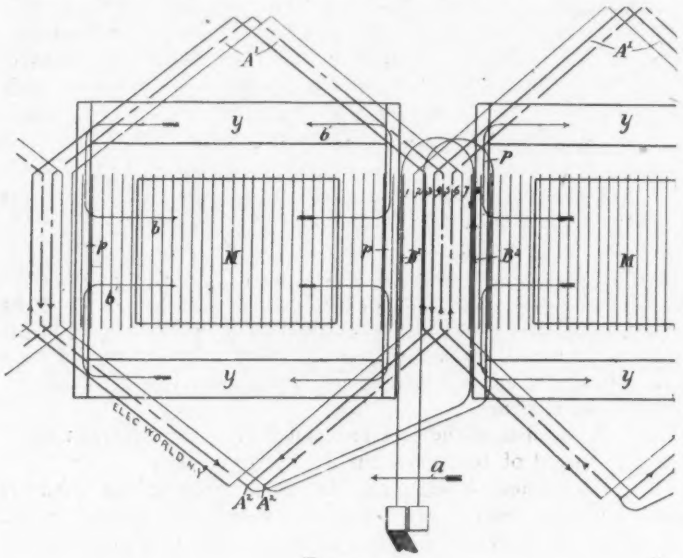


FIG. 3.

coils, as B^1 B^2, which just span the distance between two of these auxiliary pole pieces, *p*, shall be immediately under them when the corresponding commutator segments are under the brushes. The lines of force, then, through this auxiliary field circuit, will exert an e. m. f. between the short-circuited segments of the commutator suitable for reversing the current in the windings between these segments, this e. m. f. being automatically proportioned to the load. It may be seen that there is required no shifting of the brushes in either direction with this arrangement, and it may be run either as a generator or a motor, there being, consequently, no demagnetizing reaction on the part of the armature. The slots in which the armature coils are wound are, at the instant of commutation, not magnetically closed by a pole shoe above them, but are midway between the poles; thus self-induction of the turns is reduced. It would seem at first sight as though these extra turns in the winding would double the armature copper without a corresponding gain, but, as the commutator coils carry current only intermittently for brief periods, they can be of smaller cross section than the armature winding and, since there is no lead, and, consequently no armature demagnetization, but simply a distortion, which distortion helps instead of hinders commutation, heavier armature currents may be generated with the same field iron and copper.

In the London "Electrician" of July 8 there is described the "Sayers Automatic Third-Brush Regulation of Dynamos," this being presumably developed by the same inventor. This arrangement, which is shown diagrammatically in Fig. 5, connects the

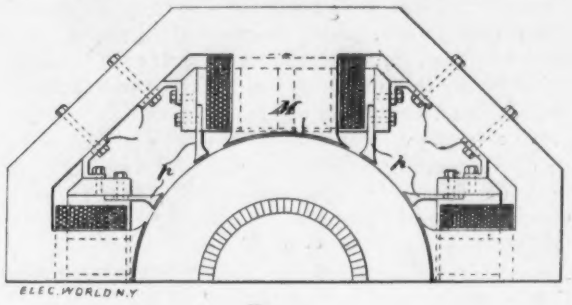


FIG. 4.

shunt field exciting coils between one of the main brushes of the machine and a small auxiliary third brush bearing against the commutator midway between the main brushes, and therefore getting on no load about one-half the full voltage of the machine. As the load rises the lines of force passing from the field poles to the armature are crowded into the following horns (in the case of generators), and—the field coils spanning these horns—the fields get more than one-half the total machine voltage, the proportion rising as the load increases. The effect is obviously proportional to the load within limits prescribed by the permeability of the system, such a machine being practically compounded or over-compounded without any series winding. It is necessary, of course, that the shunt coils of the machine be wound to give the no-load excitation with half the machine voltage across the terminals. As most machines are wound with two or more field spools in series, they

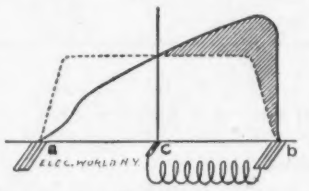


FIG. 5.

can easily be arranged for this modification by simply multipling the coils and adding the pilot brush. Curves are shown in the contemporary referred to, giving the results of tests made on such a machine with a capacity of 300 amperes and 120 volts. It is said that the pilot brush, which was of carbon about one-fourth of an inch in thickness, gave no trouble from sparking. The characteristic curves show, as might be expected, a very satisfactory compounding effect.

The Seashore Electric Railway at Brighton, England.

From the fact that the Society of Engineers recently paid a visit to this odd railroad, it appears that it has been rebuilt since its destruction by the force of the waves about two years ago. The line is about 3 miles long, the rail level at its deepest portion being 15 feet below high-water level. The car, 46 feet x 22 feet in size and weighing loaded about 50 tons, is supported on the trucks by steel tube columns, the deck being 25 feet above the rail level.

Electrical Power Distribution in an English Dock Yard.

All of the shop machinery at the Portsmouth dock yard is to be driven by electric power according to "Industries and Iron." The magnitude of this proposed installation is well shown by the estimated cost, which is one-half a million sterling.

The De Laval High-Pressure Steam Boiler and Turbine.

A clear description of the working mechanism of this remarkable turbine shown at the Stockholm exposition has been translated by the "Iron Age," from which the following is taken:

The boiler, *A*, consists of a single long pipe of small diameter, curled in a helix, A^1, over which the products of combustion pass. The fuel is fed at the top of the boiler, and is carried to the fireplace through the central chamber, A^2, the lower end of which ends above a cone of masonry, which spreads the fuel on the surrounding basket-shaped grate. The air of combustion is forced into the fireplace by means of a blower, partly through the flue, A^6, which enters below the grate, and partly through A^5, from which the air is forced through mouth pieces immediately above the top level of the fuel, where it serves to complete the combustion of the gases. Should the steam pressure rise too high, the air supply through A^5 and A^6 is cut off, and air is instead forced in through A^4, by means of the dampers in these three pipes, which are manipulated by the damper regulator shown, which consists of a piston, the steam pressure on which is counterbalanced by a spring. The water is fed to the boiler by the feed pump, *G*, which has several plungers (four in the 50-hp system, and six in the 100-hp system) in order to furnish as even a supply of water to the boiler as possible. The suction pipe of the pump is connected with the water cistern, *B*, in which is a float controlling the feed pump, so that all water condensed is returned to the boiler.

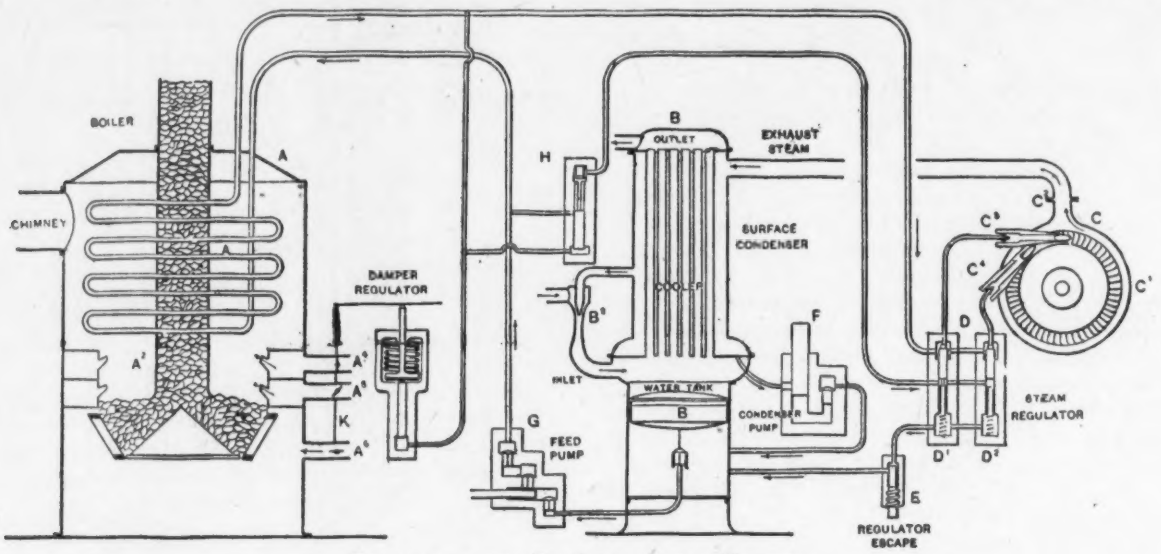


Diagram of the De Laval Steam Turbine.

The steam generated in the spiral pipe at the exhibition plant had a pressure of 1735 pounds, which at the steam turbine was reduced to 1420 pounds per square inch. The steam is first conducted to the throttles, *D*, which open one or more of the turbine nozzles, according to the load. The pressure of the water in the lower ends of the steam regulators is determined by the regulator escape, *E*, which is opened and closed by a centrifugal governor.

From the upper ends of the steam regulators the steam is conducted through four mouthpieces, or tuyeres, C^3 and C^4, with very small apertures. The turbine disc, C^1, is constructed as a double turbine with two rows of buckets and a division wall. From the tuyeres the steam passes first through one of the rows of buckets, then through the division wall, and finally through the other series of buckets. The discs make 13,000 revolutions per minute in the 100-hp turbine, and 16,400 revolutions in a 50-hp one. These speeds are reduced by gearing to 1050 and 1500 revolutions respectively at the main shaft.

The exhaust steam from the turbines passes through the exhaust pipe, C^2, to the surface condenser, *B*. The condensed steam is forced into the hot water tank by the condenser pump, *F*. The condensers are freed from air by means of an ejector, B^2, apparently operated by the cold water supply from the circulating pump.

Particularly noticeable at the power plant in question was the small floor space occupied by this combination of boiler, steam turbine and dynamo. The 100-hp boiler, which generated 1765 pounds of steam per hour, was only 4.6 feet in diameter and 9.8 feet high.

The Mental and Moral Influence of an Engineering Training *

I have read somewhere that the chief obstacles to the progress of men are gravity, friction and natural depravity. The more you think about this statement the more complete it is. Voltaire said: "All general statements are untrue, and probably this one is also." At the bottom of this cynical witticism or witty cynicism is a certain truth, but we may take the general proposition with regard to the obstacles to human progress as fairly correct.

For some generations society has agreed to leave to the engineer the care of friction and gravity, but natural depravity has been left to ministers, lawyers, editors, teachers, the mothers of families, to anyone, in fact, but the engineer; and this is where society makes a mistake. The best corrector of human depravity is the engineer, because he must deal with conditions, while other may deal with symptoms. The engineer must always square himself with the laws of nature, which are perfect, unchanging and eternal. So far as he fails to do this he fails in his business and misses his daily bread. Other men can square themselves with human laws and human notions of morality, and so they can twist along without ever knowing the difference between right and wrong. And that is why the engineer is the best moral guide. He must have a passion for truth and the faculty of thinking straight or he cannot succeed in his business. This is no mere extravagance of words to amuse you for the moment. It is a solemn truth.

We can all remember crises involving moral issues when great numbers of the clergy—perhaps the majority—were on the wrong side because of confusion of thought and false proportion. They have mistaken a conventionality for a moral truth. Or they have been mistaken in the relative value of two moral offenses. Or they have been led away by expediency—that most dangerous guide. Every day we see the talents and the energies of able lawyers bent to defeat justice and to shield crime, and this is defended by sophistries that have lived for centuries. You remember what Macaulay said about this: "We will not at present inquire whether it be right that a man should, with a wig on his head and a band round his neck, do for a guinea what without these appendages he would consider it wicked and infamous to do for an empire."

But, on the other hand, it is the good fortune of the engineer (and into that good fortune you young men have now entered) that sophistry and ignorance will surely kill him professionally, and that his success will be in direct proportion to what he actually knows and to his determination and power to reason straight. If he does not know the stresses in his bridge or engine, if he does not know the endurance of his material, if he does not design his structure according to what he knows, he cannot long pretend, even to himself, to be an engineer. Nature, calm and unrelenting, always stands looking at him. No other man in the world has such stern and unceasing discipline, and so it comes about that no other man is so safe a moral guide as the engineer, with his passion for

*An extract from the address of Mr. H. G. Prout to the graduating class of Stevens Institute of Technology, 1898.

truth and his faculty of thinking straight. This is no mere statement of a theory, but of observed facts. It has happened to me, over and over again, to discover that I get a sounder opinion on any matter of human conduct from the engineers of my acquaintance than from men of any other calling; and this is chiefly because nature has taught them that their opinions are worthless unless they are severely reasoned from known facts. Other men, especially ministers and editors, get the dangerous trick of thinking that their opinions are valuable merely because they are their opinions.

Electrical Shop Work.

BY B. F. FELLS.

As brazing is now quite an important operation in the modern electrical shop, a brief description of the best methods of setting up and using a brazing outfit may be interesting. The object in brazing or silver-soldering pieces of metal together is, of course, to unite the several parts in practically a single piece with a joint not readily fused. If well done, the joints are hard to find. The crudest form of brazing apparatus is obtained with an ordinary forge, shown in section in Fig. 1. An ordinary portable forge, such as is used in all electrical working shops, can be made serviceable for brazing with but a few alterations. The old-fashioned brick forge with bellows requires that the space below the coal grate be enlarged, as shown in the drawing. The course of the air blast from the bellows is indicated by the arrows. This sample is given to show that effective brazing can be done even with the crudest of appliances. The process consists in placing the parts to be brazed in the fire after the coke or charcoal has been burned so that the flame is bright and clear. The methods of brazing will be described farther on.

Fig. 2 shows a more improved device for brazing. This requires two pipes which unite at *C*. One-inch pipes of iron are usually used with valves of the globe type. Any pipefitter can make it up. The top pipe receives an air blast from an air blower or compressed air chamber. The lower pipe receives ordinary illuminating gas or vaporized hydrocarbons, such as petroleum, gasoline, etc. Rubber or canvas hose-pipe connections are usually employed to connect the pipes with the gas and air supply. The air and gas mix and discharge at *D*. A perfect combustion is made and brazing can be done quickly and effectively.

Fig. 3 illustrates how a two-burner brazer may be constructed. One-inch iron or brass pipes may be utilized and provided with check valves for regulating the supply of air and gas as shown, gases combining at *D*.

The plan of the burners is such that the flames meet at a central point, increasing the intensity of the heat and hastening the brazing operation. The back and base work is firebrick.

The arrangement of the burners permits the workman to watch the work on all sides without removing it from the flame.

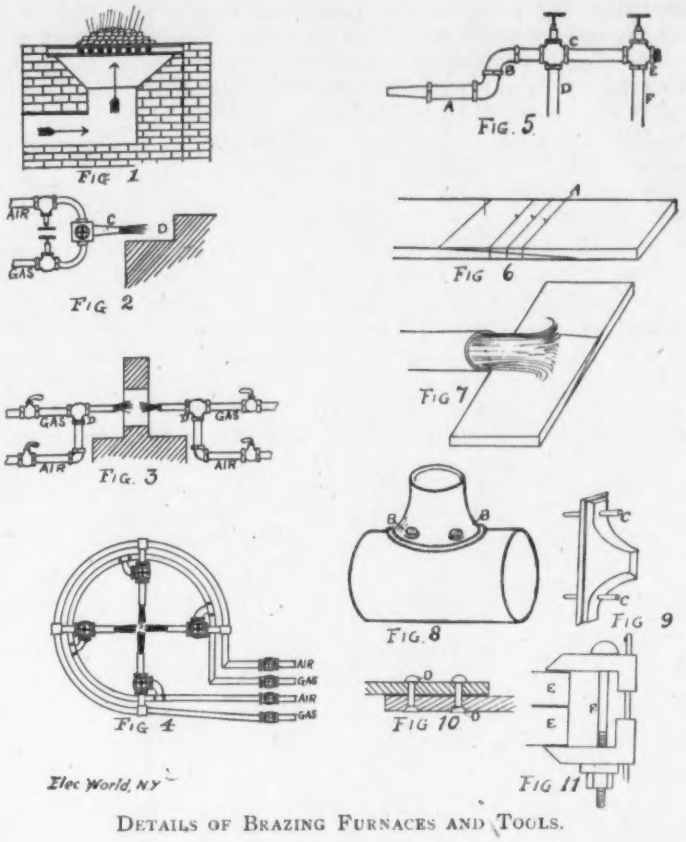
Fig. 4 shows a plan for erecting a four-flame outfit. The main air and gas pipes are bent into a circular shape and one fitted inside the other. Four pipes branch radially inward from the outer circle. Four more project from the inner circle and turn into the sides of the first pipes, as shown. The drawing shows the arrangement in plan. A fire-brick base is furnished. With this device, it is possible to entirely envelop the article in flames. The concentration of heat is intense and most effective.

Fig. 5 is a detail of one burner and will serve as a pattern. The pipes are one inch in diameter, of iron, and the joints are leaded. An air pipe, *F*, leads to the main, *E*, at which point a check valve is connected. Gas pipe *D* leads to the main at *C*, where a similar valve is put in. The combined gas and air pass to *B*, where the pipe is dropped a few inches to correspond with the height of the base of the furnace plate. The burner, *A*, is a plain piece of piping, the nozzle end of which is slightly reduced.

EXPERIMENTAL BRAZING.

Before attempting to braze important parts of electrical apparatus or other articles, experiment with some plain pieces of sheet steel. Take two pieces and lap the beveled edges, as in Fig. 6. Then wire the lap with fine wires, *A*. Next put the joint in the flames of the brazing apparatus and heat red. Both sides should be heated alike. Fig. 7 shows the flame from one of the burners directed against one side of the joint. There must be no dirt, filings or foreign stuff between the laps. Borax is the flux used. There are three kinds—calcined, broken and granulated. All three are sold at supply stores, ready to use. The borax protects the exposed surfaces of the metal from the heat, so that when the solder is applied the metal surfaces can be joined clean. Both borax and solder are alternately applied to the joint until the union is complete. As full descriptions for this work accompany the packages of borax and solder, we need not deal with the matter further.

Instead of wiring parts together for brazing, screws, pins, rivets,



DETAILS OF BRAZING FURNACES AND TOOLS.

etc., may be required. A job like that in Fig. 8, in which a flanged piece is to be brazed to a tube, could not be wired. Screws *B*, *B*, are used. Holes are first drilled and tapped. The screws are inserted, the parts brazed and then the screw heads are chipped off and the stubs filed down and smoothed over. The pin method is shown in Fig. C, in which two pieces are held together by pins, *C*, *C*. After brazing, the pins are chipped off, smoothed down, and if neatly done no trace of them will be seen. The rivet method is presented in Fig. 10, in section. The rivets are indicated, *D*, *D*, and both ends may be countersunk or left with round heads. Or the ends can be filed down smooth, so as not to show. A clamp is serviceable in some cases. Suppose parts *E*, *E*, are to be joined. A clamp like that shown can be forged, the jaws drilled for a clamping bolt *F*, and the device used to hold parts together during the operation of brazing.

The final work is cleaning off of the slag, and general corrosive matter which has accumulated about the joint. This is done with the sand blast, chipping tools, filing or grinding. The first method requires so much apparatus that the other systems are used chiefly. Final polishing is done with emery cloth.

Tests of the Isolated Plant of the Chicago Public Library.

A complete set of tests of the mechanical equipment of the new Chicago Library gives some data of interest concerning the electrical plant. Each generating unit consists of two 60-kw General Electric dynamos, coupled to the shaft of an Erie Ball vertical cross-compound engine. There are four such sets beside one smaller one. The indicated friction load was 12 horse-power, which, with field coils excited, ran up to 16.9 horse-power. The steam per hp-hour was, at full load, 24.7 pounds, and at half load 31.1. Complete tests were also made of the elevators, which are of the drum type, over counterweighted, driven by electric motors and installed by the Crane Elevator Company. The larger elevators, loaded to an average weight of 5200 pounds, and counterweighted by an average of 4400 pounds, running at 300 feet per minute and stopping at every floor, consumed 6.25 kw per car mile, the number of stops being 332 per car mile.

The Calculation of Alternating Current Generators—I.

BY ALEXANDER ROTHERT.

During the period which has elapsed since the electrical exposition held at Frankfort-on-the-Main probably the most noticeable advances in electro-technics have been in the direction of the generation and utilization of very powerful alternating currents. Both monophase and polyphase apparatus have been greatly improved and, on account of its advantage for power transmission and the running of non-synchronous motors, the polyphase system has probably received the most attention and has therefore been more completely developed. On account of the simplicity of the apparatus necessary for the generation and transformation of the alternating current a wide and constantly increasing field is open to it.

With the change from the comparatively small generators used for illuminating purposes of several years past to the immense machines used at present for purposes of power transmission many problems of design and construction have arisen, and the effect of certain reactions which are negligible in the oldet machines has assumed extreme importance in the modern power generators. In the older machines a change in the inductance of the load carried made a very great change in the e. m. f. at the terminals of the machine, and when working with loads of large inductance it was found impossible with the excitation provided to keep up the potential at the terminals. As is well known the armature reaction of alternators working on non-inductive loads is not of very great importance, but this is no longer the case when the load is highly inductive and in consequence the currents lag behind the e. m. f.

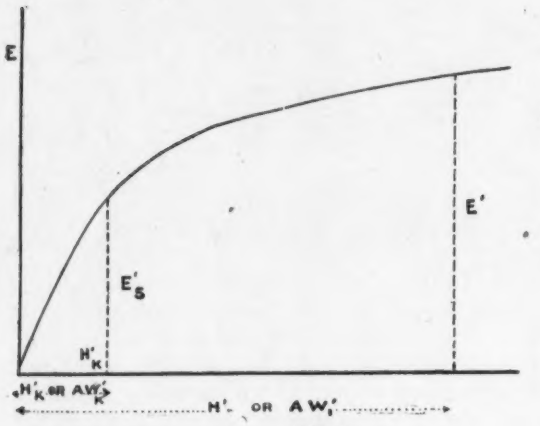


FIG. 1.

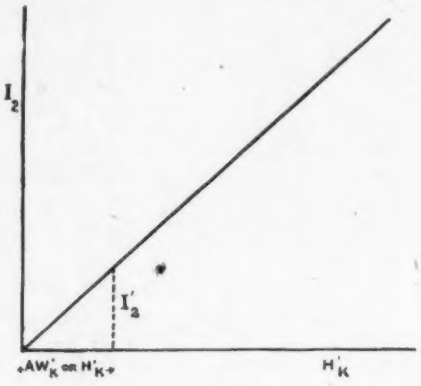


FIG. 2

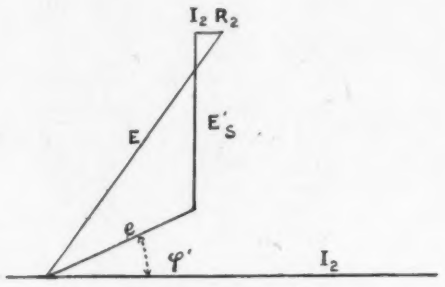


FIG. 3

Owing to the reaction of the lagging current it is necessary to provide greater exciting power in order to prevent the terminal e. m. f. from dropping when the load is increased. For this reason power generators were provided with more powerful fields and in consequence relatively fewer turns on the armature.

In this manner it has become possible to construct generators capable of carrying heavy inductive loads with comparatively little drop at the terminals from light to full load.

On account of the lack of a proper theory, designers and constructors were reduced to the necessity of using empirical or "cut and try" methods for designing such machines. There was an urgent demand for a theory which would allow the predetermination of the characteristic curve of the machine when working on loads of different inductances. Gisbert Kapp was perhaps one of the first who investigated the effect of inductive loads upon the performance of generators. He pointed out for non-inductive loads the effect of the inductance of the armature. He showed that if there is an inductive load the armature currents react upon the field excitation and this reaction is proportional to the angle of lag. The essential feature of Kapp's method is that he makes a distinction between the self-induction and the reaction of the armature.

The consideration of the effect of the angle of lag in Kapp's method is only approximately correct and only holds good when the lag is small.

On this account the theory of Behn-Eschenburg was welcomed as being a decided advance, especially since in it there is no distinction made between self-induction and reaction and the theory thereby becomes much more simple and comprehensible.

In order to make a careful investigation of the errors of this theory and to make a fair comparison between it and a theory to be given further on, which is free from these errors, I will give a brief description of Behn-Eschenburg's method.*

The theory of Behn-Eschenburg has for its object the determination of the p. d. between the terminals of the machine with any given excitation, when the machine is working on more or less heavy loads with various angles of lag. In other words, it is for the purpose of determining a series of characteristic curves which will show the performance of the machine as the load and also the angle of lag are varied. The abscissæ of these curves are the excitations and the ordinates are the volts between the terminals of the machine.

It is evident the p. d. between the terminals is the resultant of the impressed e. m. f. and of the ohmic and inductive drops. Since these quantities are not in the same phase it is necessary to combine them by the usual method of vector addition.

The impressed e. m. f. for various excitations is obtained by running the machine at its normal speed and measuring for each excitation the volts at the terminals, the machine, of course, carrying no load. This curve may also be derived by calculation from the number of conductors on the armature, the flux passing through it, and the number of revolutions per second. This no-load characteristic is merely the magnetization curve of the machine and has the same form as the curve of induction in an iron magnet with an air gap. Such a curve is shown in Fig. 1.

The drop due to resistance and self-induction may be obtained from what is known as the short circuit curve. To obtain this the machine running at normal speed is short-circuited through an ammeter whose inductance and resistance may be neglected. To any excitation there will correspond a certain current which can be read upon the ammeter and by varying the excitation a series of such currents may be obtained. Since the ammeter is considered non-inductive and to have no resistance the whole of the e. m. f. impressed upon the armature is expended in forcing the current through the armature circuit. Since we have observed the excitation necessary to cause this current to flow we can by referring to the first or no-load characteristic curve find what the corresponding e. m. f. is. Consequently we know the drop through the armature for any given current. If the resistance of the armature is known this drop can be separated into that due to the ohmic resistance and that due to the inductance.

In order to avoid confusion in the following discussion and in the diagrams it may be well to state here that all quantities denoted by the letter H, with or without subscripts, represent magnetizing forces expressed in ampere turns, while all quantities denoted by the letter B represent total inductions or fluxes. The subscript 1 always refers to the field magnet; 2 to the armature, and r to a resultant.

The short circuit curve is shown in Fig. 2, with the field ampere turns as abscissæ and armature currents I_2 as ordinates.

The lower portion of this curve is usually a nearly straight line, passing through the origin.

In order to construct the diagram we select any excitation H_1 to which corresponds, according to Fig. 1, the e. m. f. E^1; further we select as load the current I_2 and the lag φ in the outside circuit. To the current I_2 corresponds in the short circuit curve Fig. 2 a certain excitation $H^1{}_k$; we must now find the inductive drop which corre-

*See The Electrical World, Vol. XXV. p. 742.

sponds to this excitation, $H^1{}_k$. Behn-Eschenburg obtains it from the magnetization curve, Fig. 1, which gives the e. m. f. for each excitation. Corresponding to the excitation $H^1{}_k$ (in Fig. 1), the drop due to the self-induction is $E^1{}_s$.

The diagram when constructed will appear as shown in Fig. 3. The conditions which it must satisfy are the following:

$E^1{}_s$ s at right angles to I_2 and consequently also to $I_2 R_2$ because it represents the drop due to the self-induction. The angle between I and e is that of the lag of the current in the external circuit. As is seen, the values from which the diagram is constructed are taken from the curves shown in Figs. 1 and 2. From the diagram we are able to determine the p. d. between the terminals for each excitation if the current and the angle of lag are known. This p. d. is, of course, represented in both magnitude and direction by e, and by constructing the diagram for a series of different currents and angles of lag we can from the values thus obtained plot curves, using as co-ordinates loads and terminal e. m. fs. which will show the performance of the machine when run on any load.

It is, however, not quite so simple to determine the required excitation for each load if the p. d. at the terminals is to remain constant, and it is this case which is much the most important in practice.

This theory is apparently very correct and convenient; it, however, has in common with the theory of Kapp certain unfortunate deficiencies which sometimes may cause very erroneous results.

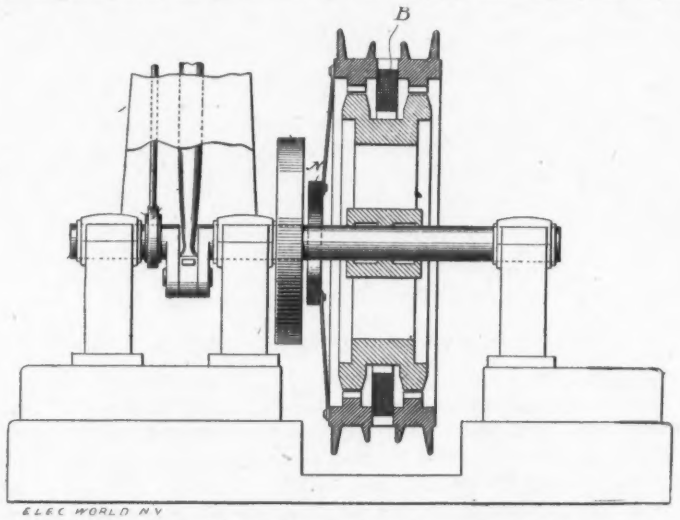
These deficiencies are as follows:

The effect of magnetic leakage is left entirely out of consideration and the effect of the diminishing permeability of the iron as it approaches saturation is completely ignored. It is tacitly assumed that the permeability of the iron is constant. E. m. fs. are combined as if to any given increase of the excitation there always corresponded the same increase of e. m. f. whether the iron is partially saturated or not. This assumption and consequently the composition of e. m. fs. is generally admissible in the theory of transformers and of polyphase motors in which the iron is only slightly saturated. With generators, however, this condition no longer holds good, for in most of them certain parts of the magnetic circuit approach or may actually attain saturation.

Under these conditions it is no longer permissible to assume that a given increase in the magnetizing force will produce a proportionate increase in the induction and consequently in the e. m. f. given by the machine. Hence the combination of e. m. fs. under these circumstances will lead to serious errors and to wrong conceptions concerning the action of the machine.

The Leakage of Magnetism into the Engines of Direct-Coupled Units.

Mr. J. F. Kelly, of the Stanley Electric Manufacturing Company, has patented an arrangement shown in the accompanying illustration for preventing the exciting coil of direct-coupled units, such as the Stanley inductor alternator, from setting up a stray field into the engine parts, the patent being No. 608,133, issued July 26, 1898.

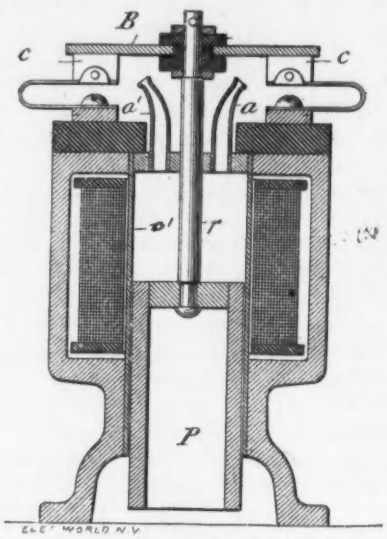


A DEVICE FOR PREVENTING INJURIOUS STRAY FIELDS.

As may be seen in the illustration, such an exciting coil, B, concentric with the shaft tends not only to set up a magnetic flux through the armature teeth and poles of the inductor where it is wanted, but also gives a m. m. f. along the shaft which, being of steel, throws quite a field into the engine. This field, crossing such gaps as those between the cranks and the lower end of the connecting rod, tends to draw these surfaces together, giving sometimes a most unaccountable binding and heating. The sensitiveness of shaft governors is also likely to be affected. To overcome this the patent claims the use of a coil, N, about the shaft between the generator and the engine, the exciting current being passed through said coil whose ampere turns are proportioned to overcome the magnetizing force set up by the main exciting coil, B.

An Arc Arrester for Motor Controllers.

Mr. Robert Lundell, of the Sprague Electric Company, has claimed in patent No. 608,134, issued July 26, 1898, a novel device for preventing arcing across the contacts of motor controllers. Instead of attempting to blow out the arcs in any way at the fingers of the controller itself, there is inserted in the main supply circuit of the controller a magnetically operated switch, shown in the accompanying illustration. The exciting coil of this switch is energized by the movement of the controller immediately before the



A CONTROLLER FLOW-OUT.

opening of any contacts therein. The current in the coil, M, attracts the iron plunger, P, which forces up by means of a rod, r, the conducting plate, B, breaking the contacts between the latter and the spring-supported fingers, c c. The movement of the plunger, P, also forces the air out from the cylinder above it, through the nozzles, a a, giving a blast to blow out the arcs which might otherwise hold between the fingers, c c, and plate, B. The circuit of the exciting coil, M, is opened and closed by auxiliary contacts in the controller.

Carbide Works in Europe.

One single manufacturer of electrical machines—namely, Schuckert & Co., of Nurnberg, Germany—reports a sale of electrical machinery for carbide-producing apparatus, aggregating over 20,000 horse-power. The annual capacity of this machinery in carbide will be about 20,000 tons. The American Consul-General at Frankfort reports that the price in Germany to large consumers is the equivalent of about $8 per 100 kilograms (220 pounds); this price running up rapidly as the size of the orders runs down.

Electric Kitchens for Hospital Ships.

It is announced in the daily press that the Women's National War Relief Association was told, in answer to its request for information as to what it could do for the hospital ships, that electrical kitchens would be appreciated. The association proposes to supply such kitchens for the ship "Missouri," now being fitted out in Brooklyn.

A Direct Reading Electrolytic Thermometer.

Messrs. Hartmann & Braun, of Frankfort, Germany, have brought out a high-temperature thermometer or pyrometer, consisting of a temperature wire, the resistance of which is constantly indicated by a direct reading ohmmeter.

The Cost of Municipal Lighting in Detroit, Mich.

The following discussion of cost is quoted from the third annual report of the public lighting commission of Detroit:

The fiscal year just closed is the first in which a municipal lighting plant of any size has had as near a thorough test as possible, and the results are awaited by those interested for and against an institution of its kind. The physical results—that is, the conversion of fuel and water into electric current—for the year will bear comparison with the results of any plant, commercial or otherwise, generating electricity. The results from labor will not compare as favorably for the reason that slightly higher wages are paid and much shorter hours of work obligatory.

The commission considered that the plant, operated under its enforced conditions, should produce an arc light of 2000 candle power for the year at about $50, and the heads of departments were instructed accordingly. The first step was the reorganization of the force of employees. The heads of departments and clerks were put on the salary list, and made subject to call for work at any time, day or night, without extra compensation for work in excess of eight hours per day. The operating crews were assigned work in three divisions of the day; i. e., from 8 A. M. to 4 P. M., from 4 P. M. to 12 M., and from 12 M. to 8 A. M. The repair crews and clerks were assigned to duty from 8 A. M. to 5 P. M., with a noon hour for dinner. Employees in the operating crews having similar duties were allowed to exchange shifts between themselves. The arbitrary shifting of crews was abolished and the former relief crews done away with. This resulted in a marked saving of labor and in station maintenance supplies. The item of trimming was a very heavy one, and the routes for trimmers were rearranged, increasing the work from an average of 59 lamps to 74 lamps and 7⅜ miles average length of routes. The work of each trimmer, however, was calculated to be done in about seven hours, the trimmer walking his circuit, and no work to be required of the trimmer after completing his circuit.

By these economies the commission was able to reduce the cash outlay per lamp from $64.19 per annum for a monthly average of 1564 lamps for the preceding year, to $51.85 per annum for a monthly average of 1744 lamps. The reduction was largely in the item of labor, being reduced from $43.57 per lamp to $33.27 per lamp, while the reductions in the cost of supplies was from $20.62 to $18.58 per lamp.

To arrive at the cost of an arc lamp to the city of Detroit per annum, there should be added to the above cash cost of $51.85 a certain amount for interest on the investment, for loss of taxes through the plant not being owned by private parties and for depreciation. The first two items are easily computed, for the average investment for the year was, in round numbers, $750,000, with interest at 4 per cent., and the assessed value of the same was placed by the city assessors at $400,000, with the rate of taxation at $17.68 for the city and at $3.24 for the State and county, a total tax of $20.92 per $1000; but with the latter—that is, the figuring of the depreciation—there is a wide difference of opinions. As per the statistics published by the London "Electrician" it is customary for the municipal lighting plants of that country to set aside annually about 3 per cent. of the entire investment as part of the expenses for a sinking fund. The writers on the subject in scientific journals in the United States have ranged from 3 per cent. to 7½ per cent. as the amount to be charged off for depreciation or for a sinking fund. This commission held in its preceding report that a plant established and maintained similar to the Detroit city plant should not be subjected to a heavy expense item for depreciation or a sinking fund. The commission held that only a "wear" depreciation should be charged, and then only on such parts (as boilers) which, after a period of time, would have to be changed as an entirety. As a compromise, however, the commission takes the rate of 3 per cent. to set aside with the cost of a lamp per year for a sinking fund or depreciation, and the reader may change that rate as per his pleasure. Computing these fixed charges, we have:

Interest at 4 per cent. on $750,000 average investment...	$30,000.00
Depreciation at 3 per cent. on $750,000 average investment	22,500.00
Taxes at $20.92 on $400,000 assessed valuation.....	8,368.00
A total of.....	$60,868.00

Proportioning this on the basis of the electrical output and we have $55,207.27 chargeable to arc lighting, or $31.65 per annum per arc lamp. The total cost of an arc lamp to the city of Detroit per annum on these figures may, therefore, be placed at $83.50.

In February, 1893, the Detroit Electric Light & Power Company offered to light the city of Detroit for a period of ten years at the rate of $102.20 per arc lamp per year. While there are no recent bids available from which the exact cost to the city of an arc lamp by commercial companies may be obtained, it is entirely reasonable to presume that in common with all other industries the cost per lamp has been reduced at least 10 per cent. during the interval of five years which has elapsed. The cost, therefore, at present may be assumed to be not greater than $90 per arc lamp per year. For a number of reasons it is believed that the rate of $90 per year is a conservative figure, which may be justified.

Taking that assumption as correct, it will be seen that the amount per arc lamp which the city has saved during the past year, after allowing the 3 per cent. for depreciation, as compared with the cost of the same lamp by a commercial company, was something less than $7. This narrow margin, the commission believes, fully justifies its course in reducing the expenses during the past year to the lowest minimum possible consistent with the best service and the limiting conditions under which a municipal plant must always be operated.

While it is possible that improvements in some machinery may be made soon, which would cause a partial loss to the city of the value of part of its investment in machinery, on the other hand it is only fair to state that there is an equal probability of compensating improvements in other devices and which will enable the city to further reduce the cost per lamp per year. Reductions in cost, due to such improvements, of course would not accrue to the city if it already had a lighting contract extending over a period of years.

The ultimate success of the plan of municipal ownership of a public lighting plant, viewed from the standpoint of economy to the taxpayer, cannot as yet be claimed to be assured in the city of Detroit. Time is an essential element of consideration in arriving at a judgment at all valuable upon this question. The plant, the business of which we have the honor to administer, has been in existence since April, 1895, but it is only since November 1, 1897, that the construction feature of our business was completed and the plant placed upon a purely operating basis. This period is entirely too short to justify absolute conclusions as to the ultimate success of the municipal venture from an economical view.

The margin of profit per lamp at the present time, while it is not large, nevertheless is a showing to the advantage of the city, which it is to be hoped will be maintained or increased in the future. It is but just to observe in this connection that the quality of light furnished has been uniformly of the full standard of 2000 candle power, which is better than was found practicable to obtain of contractors; and also that collateral advantages not easily reducible to terms of pecuniary value have accrued to the city by reason of its operation of its own lighting plant. The results, such as they are, have been secured by the commission only by the practice of the strictest economy and the rigid exclusion of all of those elements so apt to intrude into the administration of public municipal affairs, and which operate only to confound business principles and political expediency in perplexing entanglement. It has not been at all times easy to persuade some that these two policies occasionally clash irreconcilably, and, in the determination of the one or the other to be followed, it was the duty of the commission to be guided solely by the interest of the taxpayer.

An Improvement Over Ash Hoists.

A novel form of sidewalk ash elevator has been installed in connection with the boiler plant of the United States Appraiser's Warehouse in New York City, the work having been done by the Link-Belt Engineering Company. The elevator consists of an endless chain carrying buckets which scoop the ashes from below and deliver them above the sidewalk into a spout, which shoots them into wagons. The spout folds down into the main frame, which is telescopic and can be lowered below the sidewalk when not in use. The capacity of the machine is about fifteen tons per hour.

DIGEST OF CURRENT ELECTRICAL LITERATURE

AMERICAN AND FOREIGN

By Carl Hering

Lights and Lighting.

REMOVABLE LAMP BASES.—"Zeit. f. Beleucht.," July 20.—The beginning of an article from "Dinglers' Polytech. Jour.," giving brief, illustrated descriptions of the various forms of removable lamp bases which have been devised. They are divided into two classes, one in which only a part of the base is removable and the other in which all of it is removable. The base is an expensive portion of the lamp, and it is claimed that the price of lamps would be reduced by making these bases removable, so that those from old lamps can be used again; this would enable lamps to be kept in stock without bases. any desired base being afterward attached; in many of these the plaster of paris joint, which has proved to be so troublesome on account of the moisture, is avoided.

ELECTRIC PRINTING IN PHOTOGRAPHY.—"Elek. Anz.," July 3.—A brief, illustrated description of the Schwarz apparatus, in which arc lights are used to replace sunlight for photographic printing. The apparatus consists of several arc lamps behind each of which there are three plain reflectors at right angles to each other and covered with white enamel; the lamps are conveniently mounted on a stand. To illuminate a surface of 1 sq. m. uniformly requires four lamps arranged at the corners of a square. Prints are made with this in fifteen minutes to one hour, according to the current strength and sensitiveness of the paper.

Power.

POWER DISTRIBUTION IN FACTORIES. Mavor. Lond. "Elec. Rev.," July 22.—A brief abstract of a recent paper, the original of which contains tabulated replies received from a number of manufacturers, to inquiries which he made; he divides these into two groups, one for weaving and spinning, corn and flour mills, and engineering works, in which the power is derived from one or two large engines, and the other for paper mills, chemical, sugar refining and engineering works, in which the power is derived from a number of small engines. In the first group the average coal consumption per indicated hp-hour is 3.1 pounds, and the total cost of the power, including labor, is 0.26 cents; for the second group these figures are 5.3 pounds and 0.448 cents. He also gives the particulars for a foundry in Glasgow, where nineteen small engines were replaced by one gas engine of 120 horse-power, driving hydraulic pumps and a dynamo; the net result of the change was a saving of $300 per month in cost of fuel and from $400 to $500 per month in the saving of working expenses. He concludes with some advice as to the best way of making the change; it is a bad plan to use an old engine to drive a dynamo, or to use the old boilers, and he advises a separate, new installation of an efficient type, sufficient to replace the isolated engines, and leaving untouched any old engines that are working with fair economy, especially those working groups of machines through shafting; after the economy of this change has been found, the question of making the complete change can be safely answered.

PLANT AT CREUSOT. Lond. "Engineering," July 22.—The conclusion of the description noticed in the "Digest" last week; illustrated descriptions of various electrical machinery made by that company are given.

GAS ENGINE INSTALLATIONS. Koerting. "Elek. Anz.," July 3.—A reprint of a recent lecture on the cost of operation of gas engine plants, including data and conclusions favorable to gas engines.

TRANSMISSION AT VERY HIGH VOLTAGES. Bly. "Jour. of El'ty," July.—A reprint of a Pacific Coast Elec. Trans. Assn. paper, in which he makes certain recommendations which he considers good practice for transmission at extremely high voltages. Extremely high efficiency in the transformers is not desirable at all times, as its attainment is accomplished only at the expense of reliability; the transformer and line losses should be considered collectively, and not individually. Oil is indispensable for the insulation in such transformers; one-eighth of an inch of mineral seal oil will require, with an alternating current of 60 cycles, a little over 20,000 volts to be punctured, and this is about 6 or 8 times what is required to jump across a similar air gap; hard wood, such as maple or walnut, when properly treated with oil, is one of the best materials to be used for supports of the coils of such transformers. He acknowledges the comparative success of the Wurts lightning arresters. He prefers glass to porcelain for the insulation, and lays special stress on the construction of the supporting pin, which he claims is as important as the insulator itself; he objects to pins of or containing iron, and recommends those that are strictly non-conducting, like those made of prepared wood, which have been found very satisfactory. He points out the importance of the capacity of the line under these high voltages, especially on very long lines; it may be practically neutralized by a reactance, but such a system is very difficult to regulate, as the balance is easily disturbed.

ELECTRIC MOTORS IN PAPER MAKING. Bell. "Cassiers' Mag.," August.—A short article in which he makes an estimate of the cost for a typical case, including the first cost and operating expenses. He concludes that the best field for electric motors in paper making is in reducing the cost of power; by this means a mill can be located so as to obtain its material and ship it economically, at the same time having the advantages of a cheap water power; electric transmission enables the plant to be located with reference to shipping as well as to the water power. With coal at $3 per ton electric transmission of 500 horse-power or more, with an average water power within a radius of 15 miles, will pay nine times out of ten. He discourages the use of electric heating, recommending producer gas instead.

CENTRIFICAL PUMPS. Richards. "Jour. of El'ty," July.—A reprint of a short Pacific Coast Elec. Trans. Assn. paper. He shows that centrifical pumps are especially well adapted to be driven electrically; their disadvantages are the constant duty and the speed of rotation; the former is overcome by subdividing the plant into smaller units and the latter, by the adoption of what he calls the conoidal system.

BUFFALO TRANSFORMER STATION. Dunlap. "West. Elec.," July 30.—A brief, illustrated description of the first section of the permanent installation.

HIGH-SPEED ENGINES. Peache. "Cassiers' Mag.," August.—After a brief discussion of the conditions to be met by high-speed engines and their limitations, he gives brief, illustrated descriptions of a number of British high-speed engines for electric light and power stations.

PACIFIC COAST ELEC. TRANS. ASSN.—"Jour. of El'ty," July.—Verbatim reports of the proceedings of the second annual convention; the papers are also reprinted in that journal, which is the official organ of that association.

Traction.

BRAKES FOR STEEP GRADES.—"L'Eclairage Elec.," July 16.—A note stating that a system used on Swiss railways consists in the use of two shoes of steel, one on each side of the car, provided with points; they are mounted so as to be readily lowered to come in contact with wooden girders placed along the sides of the track. A car weighing 9.5 tons and running at a speed of 10 km per hour, was stopped within a space of 2 to 4 meters on a grade of 9.2 per cent.; some of the details of the test are given.

AUTOMOBILES.—"L'Energie Elec.," July 1 and 16.—This double number is devoted entirely to illustrated descriptions of the various vehicles in the recent Paris test, together with tabulated results of these tests.

BLACKPOOL.—Lond. "Elec. Rev.," July 22.—A brief, illustrated description of the electric trolley line from Blackpool to Fleetwood.

POWER CONSUMPTION IN RAPID TRANSIT SERVICE. Carus-Wilson. "St. R'y. Jour.," August.—A reference to an article on this subject by Armstrong in the June issue of that journal, in which it was stated that the greatest economy in railway service can be secured by driving the motors at a high rate of speed at first, and then allowing them to coast, rather than to drive them at a lower rate of speed and coast a shorter distance. Carus-Wilson analyzes the resistance loss in both methods, and finds that it is not negligible, as stated by Armstrong, but considerable, and is greater in the coasting than in the "uniform speed" method. He considers the total losses from all causes about the same in both methods of running, but points out that with the method recommended by Armstrong about 30 per cent. more heat is generated in the motors, and that the maximum current is about 20 per cent. greater, both of which are important objections to the "coasting" method.

RECENT TRACK CONSTRUCTION OF THE SIOUX CITY TRACTION COMPANY. Wilson. "St. Ry. Jour.," August.—An illustrated description of the method of laying track in asphalt and brick pavement employed in that city. A T rail 6 inches high in 60-foot lengths was used; it was mounted on steel ties, spaced 3 feet center to center, and held together by tie rods spaced 7 feet 6 inches; under each rail was a continuous concrete beam, keystone in shape, with an average width of 15 inches and depth of 9 inches. The rails with the ties, etc., were first placed in position and supported on wooden blocks, and was all surfaced, lined and gauged; the concrete was then placed under the rail; as the concrete had to set for eight days, the track was exposed to the sun during this time, and its expansion and contraction, owing to differences in temperature, amounted to from 3 to 4½ inches in 400 feet; to hold them in uniform temperature, the rails were cov-

ered with inverted V-shaped troughs during this time. The ends of the rails were butted close together, but no trouble from the track getting out of line has been experienced. In asphalt paving stone blocks, close to the rail, are used. The formulas for mixing the concrete, etc., are given in the article.

THE ELECTRIC RAILWAY SYSTEM OF SPRINGFIELD AND HOLYOKE.—"St. Ry. Jour.," August.—A well-illustrated article. The principal feature of the Springfield road is a new car house; there is only one entrance track. This allows the use of a small door, so that in winter there is no difficulty about keeping the car house warm and washing the cars when in the car house. The overhead contacts in the car house are made up of angle irons instead of wires, and are consequently rigid, so that the trolley pole does not slip off. The station is being reconstructed, and will contain four 1200-hp engines. In Holyoke, forced draught is used in the power station instead of natural draught, and the results are satisfactory; the system includes a mountain inclined railway, on which two mountain cars connected by a cable are operated; each car is equipped with motors and these furnish the only power, the use of the cable being simply to balance the dead weight of the two cars when one is ascending and the other descending; the grades are from 7 to 21 per cent., and average 14 per cent. Another novel feature of the incline is that it is a single track road with a turnout in the center; here a special arrangement of rails permits the passage of the cable through the tracks; auxiliary rails are laid outside of the regular rails; at these points the car is carried on the auxiliary rails by means of an extra pair of wheels mounted on each car axle. No rack rail is used; but there is a safety rail along the entire length of the line, which can be gripped by an automatic device located under the car in case the normal speed is exceeded.

NEW ELECTRIC RAILWAYS IN VIENNA AND ITS ENVIRONS. Ziffer. "St. Ry. Jour.," August (International Edition).—He mentions a number of new electric railway enterprises in the neighborhood of Vienna; two in particular, which are to be built immediately, are one from the Praterstern to Kagran and one from Vienna to Baden. The franchise conditions are given in detail, and include the right of the city authorities to take over the property upon paying a price fixed in the concession; the profits above a certain amount are also to be divided equally between the city and company.

THE HALIFAX CORPORATION ELECTRIC TRAMWAYS. Wilmshurst. "St. Ry. Jour.," August.—An illustrated description of the electric railway system, which is about 4 miles in length; about 13 miles in addition will be installed; the costs of construction are given. The steepest grade is 1 in 12.3; power is taken from the electric lighting station owned by the city; the rail used weighs about 98 pounds per yard; the cars are equipped with three brakes, the ordinary hand brake, an electric brake and a track brake. In the station are two 120-kw generators, and a battery of 275 chloride accumulator cells.

THE BROOKLYN ELEVATED RAILWAY MOTOR.—"St. Ry. Jour.," August.—A full description with half notes and efficiency curves. The motor is well ventilated at the sides, as its use on an elevated railway does not require that it be inclosed; the armature core is also ventilated.

THE ST. LOUIS, BELLEVILLE & SUBURBAN RAILWAY.—St. Ry. Jour.," August.—This is a high-speed electric line 14 miles in length, leading out of St. Louis. The rail is a 60-pound T, laid on oak ties resting on a ballast of cinders 6 in. in depth, which in turn rests on a clay bed. The cars measure 43 ft. over all, and make a speed of 60 miles per hour, in places.

THE HOLLAND & LAKE MICHIGAN RAILWAY.—"St. Ry. Jour.," August.—A description of a short line 7 miles in length, in Michigan; it is built across country.

WATERLOO AND CITY RAILWAY.—"St. Ry. Jour.," August (International Edition).—A brief, illustrated description of this underground railway in London, to which several references have already been given in the "Digest."

ELECTRIC TRACTION. Quin. "El'ty," August 3.—A reprint of the paper noticed in the "Digest" July 16.

Installations, Systems and Appliances.

CENTRAL STATION ACCOUNTS. Lond. "Elec.," July 22.—An analysis of the accounts of the Eastborne and the Tunbridge Wells stations.

(As accounts similar to these for different stations are published each week in that journal, they will not again be noticed; each article is headed with a list of the stations for which the accounts have been published, and the respective date of the journal. Central station accounts are also published occasionally in the Lond. "Elec. Eng." and Lond. "Elec. Rev." Attention is also again called to the fact that Lond. "Lightning" publishes weekly a four-page table of an analysis of the accounts of a very large number of stations. It also contains discussions of the accounts of several stations each week.)

ACCUMULATORS WITH LIGHTING AND TRACTION SYSTEMS. Rider. Lond. "Elec. Rev.," July 22.—The beginning of a reprint in full of the paper noticed in the "Digest" July 30.

Wires, Wiring and Conduits.

RULES AND REGULATIONS.—"Elek. Zeit.," July 21.—A reprint of those adopted by the German Union of Electrical Engineers; it includes also a number of conventional signs to be used in making drawings. In an appendix it is stated that the specific resistance of copper is to be expressed in ohms for a length of 1 meter and a cross-section of 1 sq. mm. at 15° C.; the reciprocal of this value is to represent the conductivity; copper whose specific resistance is greater than 0.0175, or whose conductivity is smaller than 57, is not to be used for conducting copper; standard copper of 100 per cent. conductivity is that which has a conductivity of 60; in calculating the effect of temperature 0.4 per cent. per degree C. is to be assumed, unless otherwise stated.

SAFETY DEVICES FOR LINES.—"Elek. Anz.," July 10.—Illustrated descriptions of a number of safety devices of the Siemens & Halske Company for overhead lines.

Electro-Physics and Magnetism.

CATHODE JETS. Phillips. Lond. "Elec.," July 22.—Vivid green specks often appear on the bulb of a Crookes' tube after the pressure is so reduced as to make it difficult for a discharge to pass, provided the negative electrode is in a bulb of soda glass; as considerable uncertainty exists concerning the origin of these patches he endeavored to show that the cathode is capable of emitting a radiation which can produce these effects. A bulb is shown in which the cathode could be rotated by means of an external magnet. The best conditions for producing these spots were found to be a low pressure, a sudden stimulation, a particular spark length, and a dry atmosphere. When the cathode was revolved the patches moved with it; they would often remain luminous ten seconds after the discharge ceased to pass; if after the current was stopped the magnet was again applied the patches moved as before, showing that even when no free charge resided on the elctrodes there was still a jet of electrified matter issuing from the cathode. These jets may be deflected electrostatically and magnetically; the patches immediately disappear when an arcing or some such disturbance took place between the cathode and another body near it and within the tube; tin-foil on the outside near the cathode also prevented the formation of the jets. These facts may account for the curious variation in connection with X-rays which has been observed. He concludes that it is probably important to have the concave cathodes of focus tubes well polished, particularly at the edges, especialy if they are highly exhausted bulbs, for the production of X-rays.

FIRE-FLY LIGHT. Muraoka and Kasuya. "Wied. Ann.," 64. p. 186; abstracted in "L'Eclairage Elec.," July 16.—They found that the action of this light on photographic plates was not an electric phenomenon, as was suggested by Stokes; the plates were found to be affected by solid and liquid bodies, and they attribute the effects to the vapors emitted by these.

CONSTANCY OF MAGNETIZATION OF BAR MAGNETS. Mme. Curie. "L'Eclairage Elec.," July 16.—A very long abstract from the "Bul. Soc. d'Encouragement," 3, p. 63. The article gives the results of very extended researches and the abstract reproduces much of the useful data, which, however, is not in such form that it can be given here; the results will doubtless be of considerable value to those interested in the subject; a few of the results are mentioned in the following synopsis of the paper. She endeavored to find under what conditions the magnetization of a bar magnet will remain most constant; she studied the effect of reheating at a slightly greater temperature, with a number of different magnets and under different conditions. It was found that re-heating, even at low temperatures, diminishes the coercive force of the hard steels in proportion as the steel is better for making good magnets; they should not be heated at 200° C. if it is desired to make them constant, as the steel then loses 50 per cent. of its coercive force, and the magnetic qualities are considerably altered; hating to 100° involves a loss of 12 to 13 per cent.; it seems best to heat them for twenty-four hours, for instance, at 60 to 70° C., and then the loss will be only 1 to 3 per cent.; the intensity of the permanent magnetism also varies with the reheating, but the variation is rather complex, the results obtained differing between each other. The action of shocks on a saturated magnet was investigated; the number of shocks required for diminishing the magnetism a certain amount were measured; in general the new value is obtained more quickly as the shocks have less effect, but there were differences in the different bars used; for hard steels the limit is more quickly reached. The effect of shocks was also investigated on bar magnets which were partially demagnetized; the effects of shocks were then less; by a partial demagnetization, therefore, one can make a bar magnet so that it will not be affected by shocks. The effect of reheating at a relatively low temperature, on the state of magnetism, was also investigated; it was found necessary to use bars which were not magnetized to saturation if it is desired that their magnetization remain constant with the variations of the temperature of the surrounding air. The variations of the intensity of bar magnets with the temperature was investigated; a bar of hard, tempered steel reheated at 60°, magnetized to saturation and demagnetized by 1-10 of its maximum permanent magnetization, will then have a magnetization which always has the same value for a given temperature. The variations of the magnetization produced by external magnetic forces was investigated; the force required to demagnetize them by 1-10 was measured; the exceptionally high value of 27.5 units was required for a magnet made of Boreas steel. Finally she discusses the constancy of the state of magnetization; the magnet which was often used as the standard in these experiments remained constant to within one-three-hundredth of its value during fifteen months; to make a

magnet independent as much as possible of external actions without depriving it of too much of its magnetization it should be reheated at only 60 or 70° C. during a long time, say forty-eight hours, then magnetized to saturation and finally demagnetized partially. For a bar magnet 20 cm long and 1 cm in section one can obtain 0.9 of its maximum permanent magnetization ;it will then stand quite energetic shocks and variations of the surrounding temperature without an appreciable variation of the state of its magnetization; the constancy will be still better if it has been demagnetized still more, but the magnetism then becomes more susceptible to the effect of external fields; it is possible to reach a state in which fields below 5 units do not produce greater permanent variation than 0.2 per cent., and that fields below 16 units do not produce a variation of more than 1 per cent.; it is very necessary to avoid with care bringing it in the neighborhood of other magnets; a pole of 500 units at a distance of 10 cm can produce a dangerous effect; but even when thus treated one cannot be sure that the magnet will not vary thereafter; one can only say that the probability that its magnetism will not vary is very great.

ROENTGEN RAYS. Rollins. "Elec. Rev.," August 3.—A continuation of his long serial. He claims that the wave length depends on the temperature, and describes a tube in which a thermometer was inserted in the stream of water circulating behind the focus plate; by this he found that a higher voltage was required to produce Röntgen rays of a given wave length with cool and with warm water; by using a lower voltage or vacuum and increasing the number of impacts by increasing the current, an uncooled target can be made so hot that it radiates ordinary light and yet the tube will not yield any Röntgen rays; in practice a very high temperature of the target is not desired; with a very high vacuum and voltage a temperature could be produced perhaps higher even than that of the sun, and at this some of the elements can, he claims, be decomposed. He discusses having the target separate from the anode and near the cathode; in an illustrated tube the target is between the terminals, and the velocity should then be greater than when the target is the anode; with a given voltage light of a shorter wave length should be generated, or of the same wave length with a lower voltage, which latter means a smaller generator; if the voltage could be high enough the vacuum tube could be discarded and the Röntgen "light" could be produced without them. He then discusses the size of the cathodes; to overcome some difficulties he claims that it should be 2 inches or more in diameter, instead of being less than 1 inch, as is usual; the size of the cathode should be in proportion to the size of the surges. At some stages of the vacuum only the edges appear active, while at a higher vacuum only the centre seems to be the source, and it has therefore been thought by some makers that a small cathode is as good as a large one, but this, he claims, is a fallacy.

Electro-Chemistry and Batteries.

ALUMINUM ELECTRODES. Wilson. Lond. "Elec. Eng.," July 22.—The continuation of his long Royal Society paper (see "Digest," last week). He continues the description of the tests with continuous currents: a table gives the results with the positive aluminum plate connected successively with one to twenty storage batteries; with one to eighteen cells the currents gradually increased, but with twenty cells and the plate formed in sulphuric acid the electrode gave way with great rapidity, allowing a strong current to pass; the plate formed in alum was more stable with twenty cells. The effect of temperature on the voltage was then examined, and a table of results is given, showing that for a rise of temperature from 13.5 to 70° C. the voltage falls from 30 to 3 volts, from which he concludes that temperature has an effect on the apparently high resistance of the aluminum plate and its film; in practice, therefore, when a high resistance is required it is necessary to cool the cell. Tests were also made with the plates immersed in mercury; the film formed on the aluminum plate is discussed; it is formed by simple immersion in alum and subsequent exposure to the air, and it has the same effect as the film formed with the current. He then begins the discussion of the tests with alternating currents, the object of which was to see if the effect described in the first part has time to properly develop at ordinary frequencies, and also to see whether aluminum is a good metal for condensers. With the ordinary frequencies and the cells he used a uni-directional current was not obtained, even if the time taken to develop the effects was very small compared with the time of the complete period; the results of the tests are tabulated, and show that small currents are accompanied by a large phase difference, but the large ratio between the maximum coulombs in the two halves of a period, mainly develops with large currents for a given frequency, accompanied by high temperature and small phase difference.

CONNECTIONS FOR ELECTROLYTIC WORK.—Lond. "Elec. Eng.," July 22.—A brief mention of a recent paper by Dessauer on the Carlin method of making connections, which appears to be used in the gold fields of South Africa. It consists of a tube filled with mercury, which is accessible for making contacts by having holes drilled through the upper part, into which wires are inserted; the result is said to be most satisfactory; the loss with the former screw contacts was found to be 0.71 out of 3.82 volts, while with this method it was reduced to 0.015 volt.

MOST ECONOMICAL CURRENT IN ELECTROLYSIS. Vogel. "L'Eclairage Elec.," July 16.—An abstract of an article in which he develops, with the aid of simple mathematics, formulas for the energy required per unit of weight of the material deposited and the cost per unit of weight, from which he deduces an equation for the most economical current.

ELECTROLYTIC THEORIES. Edser. Lond. "Elec. Eng.," July 22.—A short article on the relation of these theories to commercial electrochemistry. He calls attention to the recent progress in commercial application and the importance in this development of a better knowledge of the theories; he cites Germany as an example of a country in which theory and practice in this field are developed together.

ZINC EXTRACTION. Threlfall. Lond. "Elec.," July 22.—An abstract of his recent article from the "Elektrochem. Zeit.," describing the Ashcroft process at Cockle Creek, New South Wales. Since the article first appeared it has been announced that the plant was not a success economically and is to be shut down.

MEETING OF ELECTROCHEMICAL SOCIETY. Muller. "L'Eclairage Elec.," July 16.—The beginning of an account of the recent meeting of the German society in Leipsic; it includes long abstracts of the papers. References to German reprints have already been given in the "Digest."

FUSION IN THE ELECTRIC FURNACE. Oddo. "Amer. Jour. of Sc.," August.—Abstracted briefly from the "Real. Accad. Linc.," 5, p. 361.—He investigated the effect produced by heating lime mixed with various proportions of silica and found that whenever there was an excess of lime combinations occurred only in the proportion needed to form orthosilicates.

OSMOTIC PRESSURE AND ELECTROLYTIC DISSOCIATION. Traube. "Amer. Jour. of Sc.," August.—A brief abstract of an article of a theoretical nature from the "Ber. Berl. Chem. Ges.," February.

ELECTROCHEMICAL BEHAVIOR OF CHROMIUM.—"El'ty," August 3.—A reprint of the article noticed in the "Digest" last week.

ELECTROLYTIC REFINING AND RECOVERY OF TIN. Cowper-Coles. "El'ty," August 3.—A reprint of the article noticed in the "Digest" last week.

RELATION OF CHEMISTRY TO ELECTRICAL ENGINEERING.—"Elec. Rev.," August 3.—A reprint of the article noticed in the "Digest" last week.

Units, Measurements and Instruments.

METALLIC RESISTANCES. Scott. Lond. "Elec. Rev.," July 22.—In this continuation of his long article (see "Digest," last week) he gives further tables and data which appear to be quite useful. One of them gives the particulars of the steel alloy "kruppin," which is made in Essen, Germany, and is said to be used considerably on the continent. The makers claim that it can be raised to 600° C. without ill effect. Another table gives the data for the alloy called beacon; its resistance is about forty-eight times that of copper, and it is said to be the highest resistance material in the market; its temperature coefficient is 0.0007007, specific gravity 8.1, specific resistance 85.13 at 20° C.; it is said to have been used for some time for car heating in this country, and that it will not become brittle if run at high temperatures. Another table gives the comparative costs of various alloys, showing the relatively very low cost of galvanized iron wire, which is so very largely used for resistances. The resistance of galvanized iron wire netting of No. 20 B. W. G., with 1 inch mesh and 20 inches wide, has a resistance of about 0.005 ohm per yard, and a safe current capacity of 90 to 100 amperes. The article is to be continued.

PHOTOMETRY OF INCANDESCENT LAMPS.—Lond. "Elec.," July 22.—The translation of the rules which have been approved by the German Union of Electrical Engineers; they have already been referred to in the "Digest."

METER.—"Elek Anz.," July 17.—An illustrated description of the new form of Hummel wattmeter for continuous currents.

METERS. Armagnat. "L'Eclairage Elec.," July 16.—Brief, illustrated descriptions of a number of meters, taken from patent specifications.

VACUUM PUMP.—"Elek. Anz.," July 3.—A brief, illustrated description of a pump made by Greiner and Friedrichs.

ALUMINUM CONDUCTORS. Dunlap. "West. Elec.," July 30.—A short article on the conductors used in one of the plants at Niagara Falls, which has just been finished, connecting the dynamos at the bottom of the shaft with the plant at the top of the cliff. The bars used are 25 feet in length, 6 inches wide and half an inch thick, four being used in parallel; every 25 feet they are bolted and riveted together; at the top they are connected with aluminum cables 1.25 inches in diameter and covered with rubber insulation; the ends are placed into sockets into which melted tin is poured. About 22,000 pounds are used, while the same work would require 48,000 pounds of copper; the conductivity of aluminum compared with copper of the same section is 63 to 64 per cent., and for the same weight more than double.

PHOTOMETRIC STANDARDS.—"Prog. Age," August 1.—A brief editorial discussion of the discrepancies between the various standards, with special reference to the recent determinations of Laporte (see "Digest," June 4 and August 6) and a similar table prepared some time ago by Violle.

ALTERNATING CURRENT METER.—"Elec. Rev.," August 3.—A reprint of the article noticed in the "Digest" July 23; also noticed in The Electrical World, last week.

Telegraphy, Telephony and Signals.

TELEGRAPHY BY MEANS OF ULTRA-VIOLET LIGHT. Zickler. "Elek. Zeit.," July 14 and 21.—A long article in which he proposes a new system of wireless telegraphy, the chief object of which is to overcome the objection to the electromagnetic wave system which lies in the fact that these waves are distributed in all directions, and cannot be concentrated in one direction, all methods for doing this having apparently failed. The principle of his method, which it seems he has tried with success, is based on an observation first made by Hertz—namely, that light rays of short-wave length, especially the ultra violet rays, have the property of promoting electric discharges—and his receiver is based on this fact. The transmitter consists of an arc light, the rays of which are condensed with lenses or reflectors into the direction in which they are to be sent, and at the receiving end the ultra-violet rays promote the discharge in a spark gap, which discharge will give rise to electric waves, which operate a coherer and through this a bell, a telephone or an ink writer; the apparatus is shown by means of diagrams. The condensing lens on the transmitter must be made of quartz and not of glass, as the former will transmit the ultra-violet rays and the glass will not; these ultra-violet rays are shut off intermittently as desired, by means of a glass plate, which is moved rapidly in front of the camera like a shutter on an ordinary photographic camera; the ultra-violet rays will in this way be cut off, while there will be no apparent effect on the light rays, and for this reason the secrecy of the message will be preserved; the ordinary search lights could be arranged to be used for the transmitter. The receiver consists of a glass tube, one end of which is made of a plate of quartz, so as to allow the ultra-violet rays to enter; these fall on a small, slanting plate in the tube, and forming one of the electrodes of the spark gap; 10 mm from this is the other electrode, in the form of a small ball; both electrodes are mounted with platinum; the air in the tube is exhausted to a certain degree, or is filled with a rarefied gas; the electrodes are connected with the secondary of a small induction coil, the knob being the anode and the disc the cathode; the induction coil need only give a spark of 1 to 2 cm, and should be provided with an adjustable resistance for regulating the voltage, so that it will be just insufficient to produce a spark when no rays fall on the gap; whenever the rays are received a discharge will take place; a coherer in the immediate neighborhood may be used to produce a call or any other signals. If the signals are merely to be made audible a telephone in the discharge circuit is sufficient. He begins the description of the results of a very large number of experiments which he has made, mostly with crude apparatus. He found that platinum was by far the best material for the electrodes, the charge between which is to be effected by the light; the question of the best shape of the electrodes was not so easily answered, and no definite results were obtained; the air surrounding the spark gap of the receiver was exhausted to 200 mm, which gave better results; the first tests were made at very short distances, and were then increased to 50 meters, at which very satisfactory results were obtained. Some deductions are then made from this data for greater distances, and he shows how much the light must be increased with the distance; with a 25-ampere lamp provided with a suitable reflector he thinks it will be possible to telegraph in this way to a distance of a number of kilometers; experiments with greater distances are to be carried out.

A short description of this system is also given in the "Zeit. fuer Elek.," July 17.

RELAY RESISTANCE. Hewett. "Teleg. Age," August 1.—A short article on the reduction of relay resistance and the laws governing it.

Miscellaneous.

ELECTRO-CULTURE.—"Zeit. fuer Elek.," July 24.—A reprint of a short article stating that Loemstroem, of Helsingfors, and Bailey, of Cornell, are to begin a series of researches in Finland with the application of electricity to the more rapid development of the growth of plants; they will start with the assumption that it is not the electric light which has a favorable effect on the growth of plants, but the electricity of the air, and on this basis the researches are to be conducted. Loemstroem has made researches in the direction of the growth of the vegetation in the far northern countries, and has found that the rapid development of the vegetation in the short summers of these districts was due to the electricity in the air; tests in a laboratory gave very good results, and when repeated on a field he found that corn ripened 35 per cent. earlier on that part which was under the influence of the electric discharges. He believes that the increased tendency to growth is not the direct result of the electrification of the air or the plant, but that the electricity produces chemical changes in the atmosphere; this is the problem which Loemstroem and Bailey are to investigate jointly.

ESTIMATING THE CURRENT IN LIGHTNING. Pockels. "Zeit. fuer Elek.," July 17.—A reprint of an article which appears to be similar to one noticed in the "Digest" some time ago, in which he estimates the current strength in a bolt of lightning by means of the magnetic effect produced in basaltic rocks, which have often been found to be magnetized by lightning discharges. He comes to the conclusion that the current strength is surely 10,000 amperes, and probably much higher. He believes the only other determination was the one by Kohlrausch, based on the fusion of copper wires by lightning, from which he obtained values between 52,000 and 9,200 amperes, assuming that the duration was between 0.001 and 0.03 second. "L'Eclairage Elec.," July 16, publishes a brief abstract in French.

GUTTA PERCHA. Obach. Lond. "Elec. Eng.," July 22.—The continuation of the reprint of his lectures, which have already been noticed in the "Digest;" certain tables, which are thought to be the most valuable information in the lectures, are not reproduced.

UNION OF GERMAN ELECTRICAL ENGINEERS.—Lond. "Elec. Eng.," July 22.—The continuation of the running account of the recent meeting; the present portion refers to the plant at Frankford, which was visited.

STANDARD DIAGRAMS. Jones. "West. Elec.," July 30.—A reply to the recent criticism of Jamieson (see "Digest," July 16 and 23) of the proposition made by the Chicago Electric Association. He does not agree with the criticisms regarding dynamos and motors; he does not favor a distinction between zig-zag lines and loops, and thinks the former are neater; regarding the location of the series winding he thinks the committee's diagram is preferable, as Jamieson's winding is liable to be mistaken for a rheostat; circles or heavy dots might well be added, representing the terminals of the machines; he prefers Jamieson's diagram for the motor generator, but not for the storage battery; he favors the committee's diagram for the constantly driven magneto, as Jamieson makes no distinction between a power-driven or a hand-driven one; he prefers the committee's diagrams for the various meters, as letters on the outside are liable to be confused with reference letters; he prefers the committee's diagram for the inductive resistance, and does not favor a distinction between zig-zag lines and loops; the committee's diagram of a ground is preferred; both the forms for incandescent and arc lamps are good, a slight preference being expressed for Jamieson's for arc lamps and the committee's for incandescent lamps; the solid line for the fuse is preferred, as dotted lines are objectionable; the committee's diagram for a telegraph key is more complete, but there is not much choice between the two nor between those for the transformer.

AURORA. Felch. "Pop. Sc. Mo.," August.—An illustrated article of a general character, and describing its properties and giving the different theories to account for it, including historical references. Auroras seem to depend in form and position on the distribution of magnetism; their appearance generally coincides with magnetic disturbance on the earth's surface; the summits are generally near the magnetic meridian; it is concluded that the earth's magnetic forces play the most important part; the bands are nearly perpendicular to the magnetic meridian, and the direction of the rays parallel to it; the auroras consist of electric discharges; the magnetic needle sometimes begins to agitate an hour before the appearance of the aurora, and sometimes lasts as long as twenty-four hours afterward; earth currents and those in grounded wires are often violently affected, occasionally preventing the transmission of messages and sometimes proving a source of danger; it is a purely terrestrial phenomenon without regard to outside influences. The magnetic theory must now yield to the electric theory of its cause; after mentioning briefly the theories which have been advanced, he thinks the one of Edlund is nearer the truth than any of the others; this is based on unipolar induction; the earth in rotating, induces electrification of the atmosphere, the discharges of this electrification producing the aurora; he thinks this theory the most tenable and credible of all of those advanced.

SUBMARINE MINES.—"West. Elec.," July 30.—A brief, illustrated description of the Government exhibits of such mines at the Omaha exhibition.

BIOGRAPHICAL.—"Cassier's Mag.," August.—A full-page portrait of William Henry Preece, of London, accompanied by a brief biographical sketch by Curra.

Book Review.

ATLANTIC CABLE DIRECTORY OF REGISTERED ADDRESSES, AND CODE BOOK. Published by the Atlantic Cable Directory and Code Company, New York and London. 635 pages. Subscription price in the United States, $12.50.

This work, which will be of undoubted value to all houses having foreign trade and correspondence, contains an alphabetical list of names arranged by cities and States, together with a classified business directory, telegraph and cable code, compiled by Mr. Charles P. Bruch, assistant secretary of the Postal-Telegraph Company. The telegraph and cable code contains about 115,000 code words. The gathering together of registered cable addresses in shape for ready reference will make this directory very valuable to those who may have occasion to use the Atlantic cable or opening or continuing correspondence with American or foreign business houses, and the addition of a code within the same cover affords a convenient means for condensing cable correspondence between persons having no special code already in use. The code words have been carefully selected by expert telegraphers with a view to eliminating all words which are likely to be confused with each other in transmission under any telegraph system whatever. These words will be accepted as code words by all telegraph administrations. Thousands of code words with blanks opposite are scattered throughout the book, so that the code is especially adapted as a foundation for the preparation of special codes between correspondents.

Direct Dynamos—I.*

Until man finds how to obtain electricity directly from coal, by combustion, without the agency of machinery, or by "direct conversion," as it is called, dynamos directly connected to prime movers will remain the ultimate and best means for obtaining current.

Such combinations are the most compact, safest, easiest cared for, and simplest of all arrangements of generators, and have therefore merited the most thoughtful attention, with a view to bringing the types adopted up to the highest state of perfection.

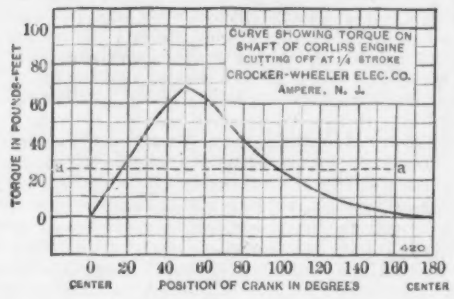


FIG. 1.

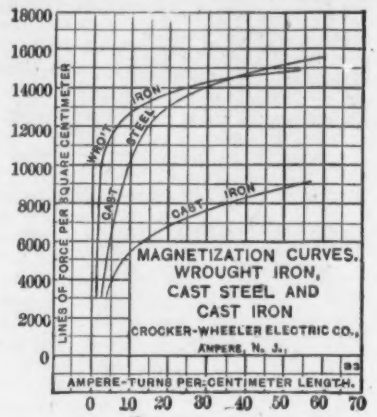

LINES OF FORCE PER SQUARE CENTIMETER
WROU'T IRON
CAST STEEL
CAST IRON
MAGNETIZATION CURVES, WROUGHT IRON, CAST STEEL AND CAST IRON
CROCKER-WHEELER ELECTRIC CO., AMPERE, N. J.
AMPERE-TURNS PER CENTIMETER LENGTH.
83

FIG. 2.

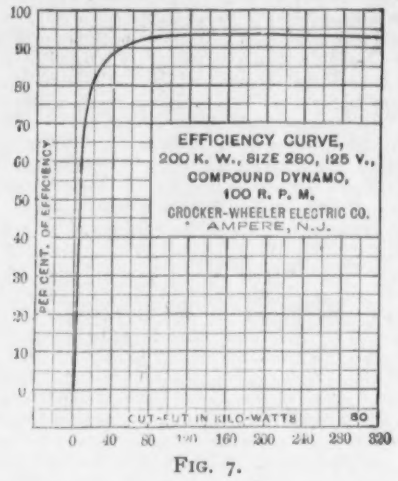

EFFICIENCY CURVE, 200 K. W., SIZE 280, 125 V., COMPOUND DYNAMO, 100 R. P. M.
CROCKER-WHEELER ELECTRIC CO. AMPERE, N.J.
PER CENT. OF EFFICIENCY
CUT-OUT IN KILO-WATTS
80

FIG. 7.

At first the direct arrangement was not looked upon generally with favor, and the pioneers in this style of construction had much to contend with in its introduction. The designs made about fifteen years ago by the Bradley Electric Power Company, since absorbed by the Crocker-Wheeler Electric Company, were far, perhaps, the earliest machines of this type brought out. The importance of direct dynamos was thus early recognized, and the type has since been under constant development by the Crocker-Wheeler Company, which, believing that only the best would survive, has made, after considerable remodeling based upon experience, a line of direct machines of the most careful design.

The advantage of direct dynamos and motors lies not in greater efficiency, but in simplicity, economy of floor space, ease of management, quiet running and avoidance of belting, although by improvements since the early machines their efficiency has been increased until it is now practically equal to that of belted machines. The chief factor in obtaining high efficiency in a direct dynamo is the employment of a large diameter of armature, so that its peripheral speed remains high in spite of the low angular velocity of the engine shaft. The greater the diameter of an armature the less must be its length, for a given output, and the greater the number of poles in its field.

In general it may be said that in a proper design the tendency to a "pancake" shape or comparatively large diameter and short length increases as the proposed speed diminishes. Relatively, direct machines are more efficient at full load, and less efficient at light load than those driven by belt.

The characteristics of dynamos are quite different from those of steam engines, and some peculiarities, in respect to their performance when united, are of interest. Engines will slow down and stop when overloaded without injury, and they are therefore not arranged with special extra capacity beyond the regular duty. A dynamo driven by an engine will submit to overload, and suffer injury, if long continued, unless the overload for the dynamo is also such a load for the engine that the latter slows down or is stalled. Dynamos will run through overloads of several hundred per cent. for a limited time with no other effect than excessive heating of their parts and sparking at the brushes.

*From advance sheets of bulletin published by the Crocker-Wheeler Electric Company, New York.

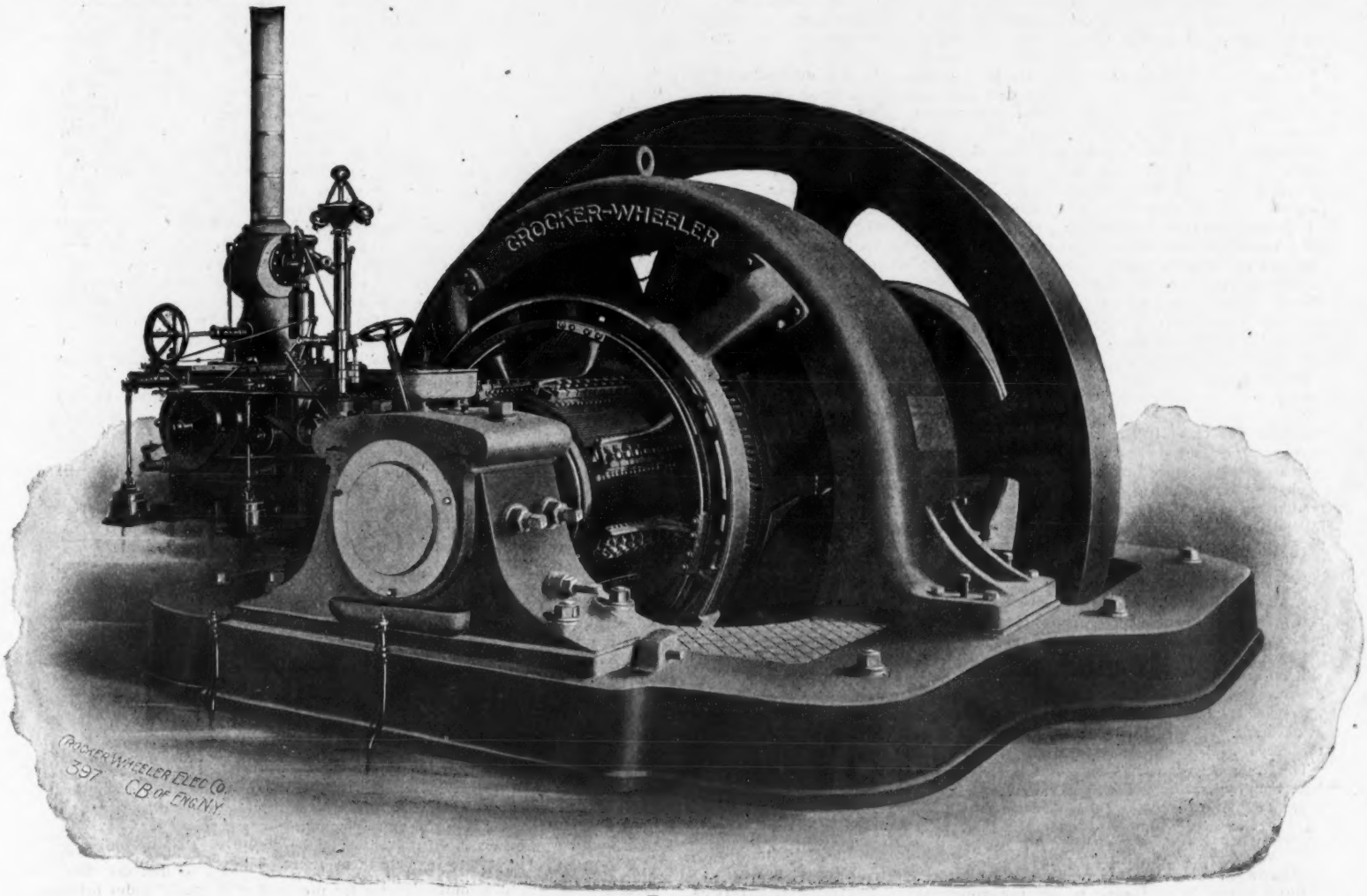


FIG. 6.

A result of this capacity for temporary excessive overloads is that a dynamo is always able, when short-circuited, to stall its engine, no matter how heavy the fly wheel.

As a dynamo absorbs power evenly at all points in its revolution, while the driving effort from any engine is pulsatory, a slight flicker is caused in the current generated, which will be noticeable unless means are provided for keeping it sufficiently small. Take as a simple case a single-cylinder, double-acting engine. As the power is delivered by the engine twice in a revolution, while it is absorbed at a uniform rate at all times, the dynamo slows down to some degree between engine strokes, causing a corresponding fluctuation in the current generated. A variation of more than one-half of 1 per cent. or one-half a volt in an incandescent lamp, being visible, a fly wheel must be used of sufficient weight to prevent the dynamo slowing down more than one-half of 1 per cent. between the strokes of the engine, when lamps are to be supplied from a single dynamo without other dynamos to keep the pressure even. This weight must be determined as follows:

The turning power imparted by the engine varies first with the varying leverage value of its crank, which gives no power when the engine is on its "centres," and gives full power at a point near the half stroke. It varies again in consequence of the changing steam pressure resulting from the expansion behind the piston.

Combining these, we have the actual power supplied by the engine, varying as shown by the curve in Fig. 1, an examination of which shows that the fluctuation of energy in every stroke—namely, that which the fly wheel has to absorb and give out twice in each revolution—is 38 per cent. of the total power of the engine.

Assuming a 200-kw dynamo and an efficiency of 94 per cent., the engine will be required to deliver 285 horse-power or 157,000 foot pounds per second. The speed being 100 revolutions per minute, or 1.67 revolutions per second, there are 3.33 strokes per second. Dividing 157,000 by 3.33, we obtain 48,000 foot pounds delivered per stroke. From the curve we learn that the fluctuation of energy is 38 per cent. per stroke. Thirty-eight per cent. of 48,000 is 17,900 foot pounds, which is the energy stored in the wheel per stroke. We must find the fly wheel which will absorb or deliver this energy without changing speed more than .4 of 1 per cent. The energy stored in a revolving body being equal to one-half its mass multiplied by the square of its angular velocity times the square of its radius of gyration, we readily find that the above condition is fulfilled by a wheel 16 feet in diameter and weighing 22,800 pounds.

All sizes of the Crocker-Wheeler direct dynamos are of the multipolar type. The determination of the best number of poles to use for obtaining maximum efficiency at the minimum complication and cost has been made with great care. It is well known that the fewer the number of poles and field coils the greater is the economy of copper for a given excitation. But in order to run sparklessly, and to give a machine an unchanging neutral space for commutation, it is necesary that the length of the air gap bear a certain ratio to the reactive power of the armature conductors under the pole. The larger the machine the greater this length, until a point is reached where it is more economical to reduce the reaction per pole by an increase in the number of poles, and thereby permit more efficient excitation across shorter air gaps.

The standard windings of all sizes are for 125, 250, and 550 volts maximum. These are the voltages at which the machines are rated; in other words, the full load current is obtained by dividing the kilowatt output by these voltages. The standard working or free voltages are 115, 230, and 500 volts. The machines are designed to give these voltages with the shunt field alone, and with considerable reserve in the field regulator. The standard series field is arranged to overcompound at full load 3 per cent. above the free voltage, though it is possible to overcompound 10 per cent. with special windings.

Compounding curves are never straight, because of the approach of magnetic saturation in the field magnets, which is shown in the curves, Fig. 2. The iron is worked at a point just about the bend of the saturation curve, and it will be seen that the lines of force, hence the voltage, do not increase directly in proportion to the magnetizing force. This means that the voltage will not rise uniformly with increase of load, but will rise more slowly toward full load than at light load. In other words, the compounding curve sags as full load is approached.

This is partially corrected by using a peculiar shunt, which is called a compounding rectifier, in multiple with the series coil of the field. The current of the dynamo divides between this rectifier and the series coil. As the load increases, the currents passing through both the rectifier and the series coil increase. The increased current in the rectifier raises its temperature, which increases its resistance considerably. The resistance of the series coil is hardly changed by the increased current, because the temperature rise is low. The relative resistances of the rectifier and the series coil are therefore altered as full load comes on, and a larger proportion of the total current is compelled to pass through the series field coils. This compensates the tendency to a deficiency in the rise of the voltage. All the standard dynamos are wound alike as regards overcompounding. The percentage of overcompounding when less than 3 per cent. will be arranged to suit the customer by adjusting the resistance of the compounding rectifier. Overcompounding greater than 3 per cent. is special and must be obtained by special winding.

The high efficiency, in spite of low speed, of the 200-kw, size 280 dynamo, which is representative of this line of machines, is shown in Fig. 7, and is due to excellence of design. It will be noticed that its efficiency curve looks like that of a belted dynamo, it is so high at light load. It attains 90 per cent. at one-fourth load, and its maximum efficiency at practically one-half load, and the curve from this point to full load is almost a straight line.

This machine, which is shown in Fig. 6, is in use at the new Columbia College buildings. For the benefit of students complete data of its parts are given on the name plate, which reads in part as follows:

Size 280. Number 3. Patented Dec. 18, 1888, May 25, 1897.
Type 8 Pole. Output 200 Kilowatts. Speed 100 R. P. M. E. M. F. 125 Volts. Current 1600 Amperes.
Total Weight 41,500 Pounds. Armature 10,500 Pounds. Efficiency at Full Load 94 Per Cent. At One-fourth Load 90 Per Cent.
Section of Armature Core 94.1 Sq. In. Of Pole 175 Sq. In.
Density in Pole 14,000 Gausses. In Yoke 6000 Gausses. Leakage Ratio 1.1.
Flux 14.6 Megawebers per Circuit. M. M. F. at Full Load 30,000 Gilberts.
Inductors on Armature 528.
Total Area of Inductors 1 Sq. In. Resistance .002 ohm.

A Visit to the Westinghouse Works.

On the afternoon of July 30 a large number of prominent engineers, on invitation, visited the works of the Westinghouse Electric & Manufacturing Company and of the Westinghouse Machine Company at East Pittsburg, Pa., to inspect some new engines and electrical apparatus which are about to be shipped to England. Among the principal objects seen were three 2500-hp generators direct-connected to three 2500-hp engines. This equipment was constructed for the Metropolitan Electric Supply Company, London, England.

The engines and generators are so designed that the full output can be obtained at any speed from 116 to 145 r. p. m., this range of speed being necessary in order to provide a variation in the frequency of the alternations, and thus enabling a supply to be given to existing transformers in London.

The engines are of the inclosed vertical compound marine type, and are the most powerful engines yet made at East Pittsburg.

The electrical apparatus built by the Westinghouse Electric & Manufacturing Company, accompanying these engines, consists of three direct-connected alternating-current generators, each having a nominal output of 2000 horse-power and delivering two-phase currents at a pressure of 500 volts. There is one direct-current multipolar exciter to each generator, which is arranged for direct-connection to the engine shaft.

This plant is to supply primarily arc and incandescent lighting to London, but a portion of the power is to be used for operating rotary transformers, which in turn supply current to direct-current motors, and for charging storage batteries by the three-wire direct-current system.

The present contract which the London company has with the Westinghouse people has a further significance for American industry. The Metropolitan Electric Supply Company, of London, is planning new central stations, and newly equipping old ones, and it is likely that the Westinghouse Companies will be called upon to supply many additional engines and generators, of thousands of horse-power capacity, before the work now begun is completed.

Apart from the machines contracted for by the Metropolitan Electric Supply Company, the gas engines and the steam turbines at the Westinghouse Machine Company's works are particularly noteworthy.

A Parsons steam turbine driving a 200-hp alternating-current generator was particularly interesting to the visitors. It runs at 4700 r. p. m. without any perceptible vibration. This speed, however, is not limited in any way. It may be either higher or lower. The bearings, which are a special feature, admit of any rotative speed that might be desired.

The turbine was driving a high-tension generator placed on the main turbine shaft, giving a voltage of 900 and an amperage of 75. This voltage was reduced to 90 for use in driving machinery and lighting electric lamps. The engine consists essentially of (1) a barrel, in the internal bore of which are fitted numerous rows of steel blades; (2) a shaft, which revolves within this barrel, having complementary blades fitted to the periphery.

By far the most interesting machinery to many was the gas engines, some of which were shown in parts, while others were direct connected to the dynamos, the power being used for electric lighting. In the engine room a 250-hp gas engine, which has been completed for some time, was seen, but was not running. The smaller engines, those from 50 to 60 horse-power, which are worked on exactly the same principle and similarly designed throughout as the larger ones, afforded an opportunity of observing the perfect regulation of these engines. The 200 electric lights, power for which was obtained from a generator direct connected to a 65-hp engine, showed absolutely no variation in intensity, thus indicating that the engine was perfectly governed. With each of the gas engines is sent a small compressor, which is belted to the main fly wheel of the engine, and used to store tanks of air for the purpose of starting the engine. For large sizes the tanks are sent to the user stored with sufficient pressure, so that the engine can be started easily and effectually.

The gas engine department is doing a large business turning out engines from 10 to 200-brake horse-power and shipping them all over the country. These engines differ from the ordinary "hit and miss" type in that the governor acts by controlling the quantity of explosive mixture which is taken into the cylinder. This results in an adjustment of the power of each explosion to the amount of work being done; hence the engine runs with the steadiness and regularity of a first-class steam engine. The regulation is so perfect that the company has built many direct-connected machines where the dynamo is mounted rigidly on the end of the engine shaft. Even under this most severe test the lights are said to be perfectly steady.

The Westinghouse Machine Company has successfully built a 650-brake horse-power gas engine. This engine has three cylinders, each 25 inches in diameter, and a 30-inch stroke, and runs at 145 r. p. m. Its economy is very marked, resulting in the production of a brake horse-power for 11 cubic feet of natural gas. This is said to be the largest gas engine in the world, and it operates with complete success.

The 650-hp engine (commonly known as the 750-horse) was running at the time, a prony brake being used to absorb the power. This engine was also designed to be direct-connected with a generator of equal capacity, and the results of tests made upon the machine show that as perfect regulation can be effected in this as in smaller sizes. The gas, which forms about one-twelfth of the explosive mixture, is drawn into the cylinders with the air and exploded by means of an electric spark, the contact being broken at the instant of the explosion. In all the engines of the Westinghouse type an explosive mixture is admitted each revolution. The governor controls the amount of explosive mixture admitted. This departure from the more common "hit and miss" method is believed by some who have been influential in the design of this and other engines, to make it possible to regulate them better. The principal ingredient of the natural gas which is used at Pittsburg is marsh gas ($C H_4$). With this gas about a thousand B. t. us. per pound can be realized, and in using it one

part of the gas is mixed with about 12 parts of air. A simple arrangement by which the proportion of gas and air can be changed as desired is placed near the gas inlet of the engine. By means of this simple device the engineer running the engine can easily determine the best proportion of mixture to be used.

There are no oil cups to lubricate the cylinders. The crank dashes the oil from a dash pot, lubricating the principal moving parts. From results of tests it is found that about 13 pounds of water are required per horse-power per hour to cool the cylinders.

The afternoon at the Westinghouse works was one of uninterrupted pleasure and instruction.

Electric Welding of Street Railway Rails.*

In June, 1893, the Johnson Company, of Johnstown, Pa., which had been for nearly a year previously experimenting with the electric welding of rails, began welding the rails of the West End Street Railway, of Boston, Mass. The apparent success then attained encouraged other roads to try the new method, and in a short time about 50 miles of track had been welded by this method in Boston, Cleveland, Johnstown, Brooklyn, St. Louis, and Detroit.

The approach of winter and with it cold weather caused the rail to contract and resulted in the breaking of many of the joints, usually just to one side of the weld, showing that the breaks were the result of a weakening of the steel consequent upon the intense heat produced by the electric current. The experiments conducted at that time determined quite conclusively that a strength of 100,000 pounds for a 6-inch rail, or thereabouts, was ample to resist the tension resulting from the annual change of temperature; 200,000 pounds was therefore assumed as a necessary joint strength. A series of tests made on short sections demonstrated that welded joints could be made capable of standing considerably more than this figure. As a result of the failure of electric welding in Boston and elsewhere, the Johnson Company refrained from a general introduction of its system and began a series of careful experiments to see if it were possible to produce the weld with its desirable features and still not destroy the structure of the adjacent steel. The solution was found to be very simple, and consists in putting the material at the weld under great pressure just after the weld is made and the current cut off and holding this pressure while the steel cools. In this way, the steel is prevented from crystallizing and losing its elasticity at the point next to the weld. The company, after further experiments to thoroughly test this discovery, is again in the market.

At present one of its equipments is in Brooklyn, engaged in welding about 45,000 feet of double track on the Nassau Electric Railroad. The welding equipment is composed of four cars, as shown in Fig. 1, containing the various electrical machinery instruments, sand blast, water tanks, regulators, etc. This train is transported about the country on flat cars, which land it as near the point where work is to be done as possible. The cars are then run onto the street railway lines, and as each car is equipped with its own trolley and motors they are propelled by their own power to the desired position.

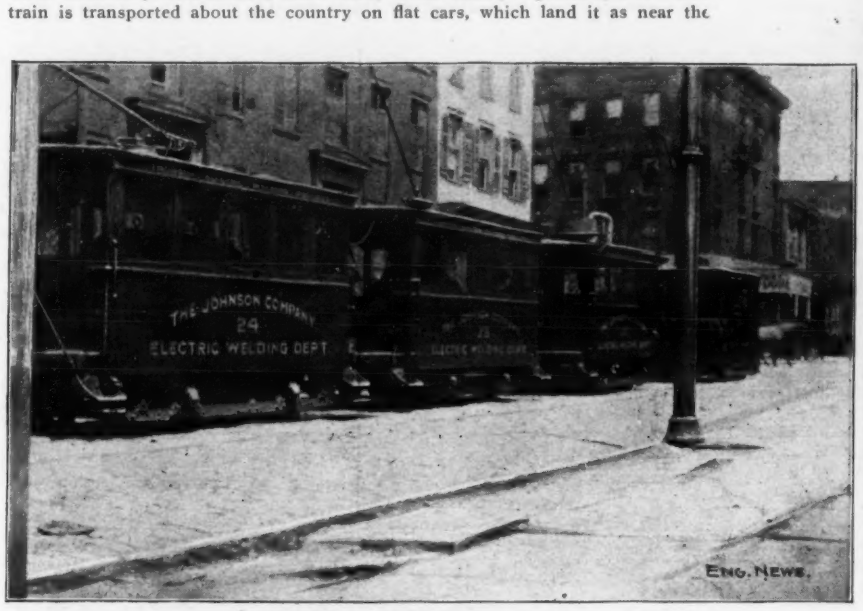


FIG. 1.—WELDING EQUIPMENT.

The car to the left in Fig. 1 contains a booster built by the Crocker-Wheeler Electric Company, of Ampere, N. J. This car complete weighs 28,000 pounds. The booster is a 125-hp, 500-volt, 200-ampere, direct-current electric motor directly connected to a 70-kw dynamo wound for 420 amperes at 175 volts at a speed of 750 r. p. m. Current for operating the booster motor is taken from the trolley wire by an ordinary trolley pole on top of the car and the altered current is carried through flexible cables to the next car where the rotary converter is placed.

In the converter car are the instruments for indicating line and booster voltage and currents in the various circuits as well as resistances for regulating the output. The rotary converter is a four-pole machine, built by the Thomson Electrical Welding Company, of Lynn, Mass. This machine has one armature provided with a commutator on one end and collector rings at the other. It runs 500 r. p. m., taking current on the direct-current side from the booster circuit and converting it into alternating current at 300 volts. The alternating current is taken from two collector rings and passes by flexible cables to the next car, in which is found the main switch, the reactive coil for current regulation, the massive welding transformer and clamp and the mechanism for moving this. Here also are the pumps, tanks, etc., necessary for cooling the jaws of the clamp.

The welder is nothing more nor less than a large transformer, mounted upon a bail, which swings from a heavy arm or crane arranged to be raised or lowered or swung from side to side by means of screws driven by a small electric motor taking current from the trolley. The transformer core is laminated soft iron wound with two primary coils for 300 volts alternating current and about 260 amperes, and insulated with oil. The secondary consists of one turn, which is only completed when welding, furnishes from 30,000 to 50,000 amperes at from 2 to 4 volts. This secondary is made up of the two casings or cast metal jackets, which surround the primary coils. The contact blocks forming the jaws of the welder are hollow and are connected with a small pump which keeps water circulating through the blocks close to the weld and thus prevents their overheating. To obviate carrying a large quantity of water it is cooled by a form of air cooler placed on top of the car, seen in Fig. 1. This is a shallow round galvanized iron tank provided with two bottoms, between which is arranged a spiral strip forming a winding passage at the centre of which air is admitted from a small rotary blower. The upper bottom is full of fine holes, and the water above this is prevented from leaking through by the air which forces its way up through the holes, producing a cooling of about 10 or 20 degrees F., as it passes out through the water.

The amount of current applied at the weld is regulated in two ways; directly, by adjusting the pressure of the jaws; indirectly, by varying the field resistance of the booster. A reactive coil is also placed in series with the primary of the welding transformer. This, however, is only used to prevent excessive sparking at the switch terminals when the circuit is broken. It consists of a simple solenoid in which is suspended a core composed of a bundle of soft iron wire.

The manner of applying the clamping to the rails is quite clearly shown in Fig. 2, in which it will be noticed that two heavy steel levers are pivoted beyond their centres and are connected at their upper ends by a double-acting hydraulic jack. A small hand pump, mounted upon one of the levers, suffices to produce any desired pressure in the jack, which is transferred through the levers to the joint.

Further forward, in Fig. 1, and always in advance of the welding train just described, is the sand blast car, containing a sand blast outfit, made by B. C. and R. A. Tilghmann, 126 South Eleventh Street, Philadelphia, Pa., an emery wheel, electric heaters to dry the sand, an electric motor and a belted air compressor. This car is cut away at the rear and is provided with canvas curtains which permit the joints to be cleaned previous to welding without scattering the sand and annoying passers by. The operator wears a helmet and cape, covering his head and shoulders.

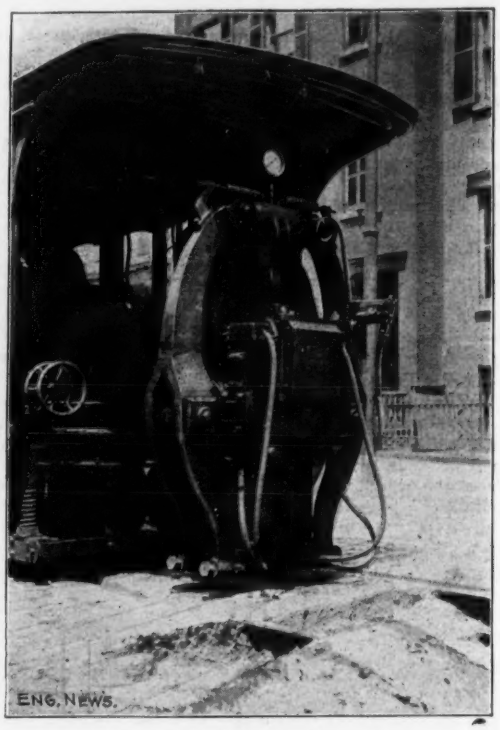


FIG. 2.—APPLYING CLAMPING TO THE RAILS.

In operation, the cars are run out at night, so as to interfere as little as possible with the schedule, and the sand blast is put to work clearing the rail joints already exposed by removing the paving for a space of about 2 x 2 feet. Shims of sawed rail sections are next wedged into place between the ends of the rails. The welding train is then moved forward until the welder hangs over the centre of the joint. Two steel splice bars, 1 x 3 inches by about 19 inches (Fig. 4), are next clamped into place, so that the central strip (a) of each bar covers the junction of the rails. The pressure on the jaws is run up to 7-10 ton, or about 1400 pounds, by the hand pump, current is turned on and the metal is watched until it welds. The current is broken and the pressure is increased to about 35 tons, under which the joint is kept until it is cooled. The jaws are then loosened and the car moved back just enough to put the jaws over the portion (b) at one end. This kite-shaped raised portion is produced

*Reprinted from "Engineering News."

by stamping the bars at the factory, so that a depression is formed on one side and the projection on the other. Into the depression on the back is fitted a flat steel stamping. Its purpose is to insure an even bearing of the clamp blocks. The second welding is next made and cooled under pressure as before, and then the weld on the opposite end of the splice bar. At the end of about fifteen minutes (during which current was on for about six minutes) the rail joint is complete and ready for use.

The amount of excavation required at the joint is small, considerably less than with the various forms of so-called cast welds. It is claimed that joints made by the welding process meet all the requirements of strength, give a certain amount of flexibility, an amount about equal to that of the rail itself, and afford an electrical bond far superior to any other form of joint.

Regarding the cost, an approximate idea can be obtained by figuring backward. There are three welds, per joint, current being on about two minutes per weld, a total of six minutes, during which close to 100 kilowatts will be necessary to operate the welder and various auxiliary apparatus. This is 1-10 of 100-kw hours, or 10-kw hours per joint. The dollars and cents of this will depend upon the particular road where the welding is in progress, being more or less according to local circumstances and the efficiency of the plant. In any case, five or six men are necessary to operate the train as described and this force will average about eighteen or twenty joints in seven hours, or between two and a half and three joints per working hour. With 30-foot rails double track there would be about 700 joints per mile, which would mean 233 hours or about twenty-four days of ten hours each per mile. To this must be added about 30 cents per joint for cost of splice bars and other pieces used. Such a joint made in the usual way with fish plates and bolts would cost about $1.80 for material, exclusive of copper bonds and all labor. Cast joints—that is, those in which from 50 to 120 pounds of cast iron is poured about the rail ends—vary in cost from $2 to $3 per joint. We are indebted to "Engineering News" for the illustrations which accompany this article.

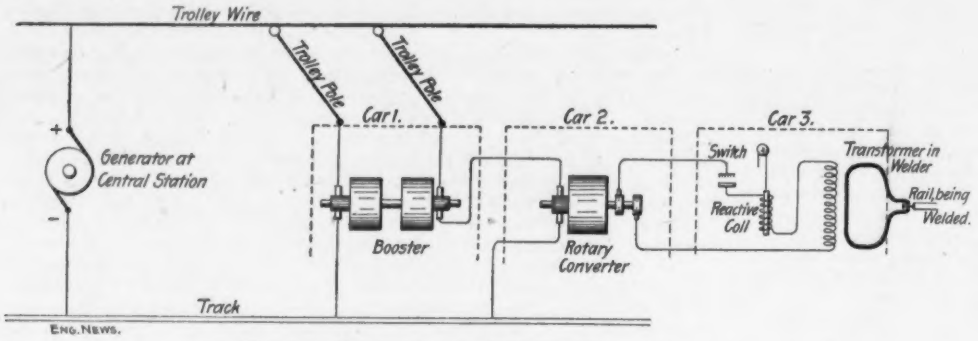


Fig. 3.—Diagram of Connections.

An Electric Bicycle Lamp.

There is an evident demand for a reliable electric lamp outfit for bicycles. The Farnham Electric Company, 616 Ashland Block, Chicago, Ill., recognizing this demand, has brought out a bicycle electric lamp outfit which is offered to bicyclists for their favorable consideration.

The outfit complete includes a small dynamo incased in a nickel-plated cylinder 3½ inches in diameter, with clamps to attach it to either the rear or front fork of the wheel. Insulated wires lead the current to a small incandescent lamp incased between a powerful reflector and lens. The cylinder containing the dynamo touches but does not rest on the tire, and is driven around rapidly by the motion of the wheel. When the wheel is in motion the dynamo is also at work and a strong light streams from the lamp. The lamp can be adjusted on any part of the wheel, and it requires practically no attention.

The lamp outfit is the invention of Mr. E. W. Farnham, an electrician, of Chicago. It weighs less than 2 pounds with all its attachments, and is dustproof and moisture proof. It has been calculated that it gives a bright and reliable light with a propelling power equivalent to 1-865 of a horse-power.

The dynamo is also applicable to other uses where a small light is desired—in surgical interior examinations, for instance, and for illuminating moving pictures, etc.

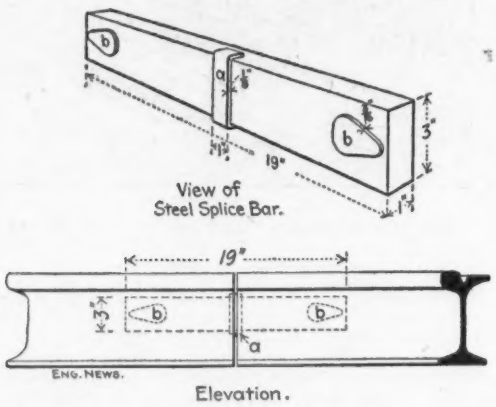
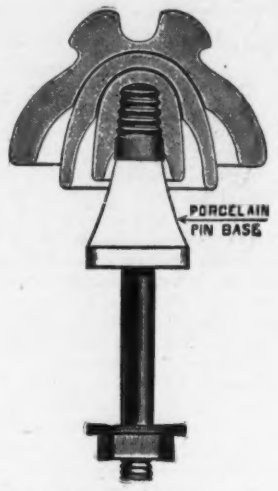


Fig. 4.—Splice Bars.

Triple Petticoat Porcelain Insulator.

The insulator of which the accompanying illustration is a sectional view is built up from three shells of vitrified china fused together with glaze. The pin has a porcelain base, which enormously increases the resistance between the cross-arm and insulator. It would be manifestly inconsistent to increase the insulating qualities of the insulator itself and not make a corresponding improvement in the insulation between the insulator and the supporting cross-arm. This, however, is completely provided for in this insulator by making the pin base of porcelain.

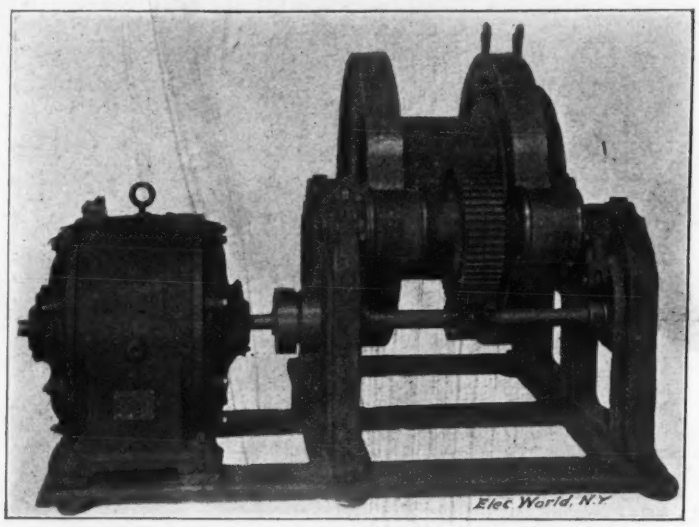


Triple Petticoat Insulator.

Mr. Fred. M. Locke, Victor, N. Y., manufactures these triple-petticoat insulators in various sizes for potentials, varying from 5000 to 50,000 volts.

Electric Mine Hoist.

The advantages attending the use of electrical machinery in mining work are now generally recognized by mine operators. Especially are the merits of such apparatus appreciated in districts where coal is hard to obtain and is consequently high in price. In many of the mining camps of Colorado plans for power transmission are under consideration, and in some cases plants are being installed. In the famous Cripple Creek district the mines will soon be able to substitute electric power for steam, and it is predicted that after another year few mines in the camp will derive their power from a steam plant. Two large transmission plants are now being installed, one at Goldfield, in the mining district, and the other at Canon City, thirty odd miles distant. Within the next year it is thought a large demand for electrical apparatus will come from the mining camp. The first necessity will be a hoist. In the accompanying illustration is shown a new type of electric hoist, to be installed in the Cripple Creek district, recently constructed by the Hendrie & Bolthoff Manufacturing & Supply Company, Denver, Col. The motor, which rests on the same base as the hoist, is placed on the driving shaft and applies its power by means of a rawhide pinion to a cut gear. On the gear shaft are two paper frictions, which bear against the friction wheels of the hoist. The motor, which is of the two-phase type, is of 15 horse-power, and was supplied by the Westinghouse Electric & Manufacturing Company. The hoist was built for the Colorado Electric Power Company, of Canon City, and, as already stated, will be installed in the Cripple Creek district.



Electric Mine Hoist.

Financial Intelligence.

THE NORTH SHORE TRACTION COMPANY reports gross earnings for June of $137,161, an increase of $6933, as compared with the same month of last year, and net $60,036, an increase of $6449. For the nine months ending June 30 the gross earnings were $986,791, an increase of $35,289, as compared with the corresponding period of last year, and net $363,985, an increase of $12,009.

THE COLUMBUS STREET RAILROAD COMPANY reports gross earnings for June of $56,502, an increase of $5284, as compared with the same month of last year, and net $28,939, an increase of $1541. For the six months ending June 30 the gross earnings were $324,389, an increase of $41,489, as compared with the corresponding period of last year, and net $167,440, an increase of $20,035.

Special Correspondence.

New York Notes.

Office of THE ELECTRICAL WORLD,
9 Murray St., NEW YORK, August 8, 1898.

CHANNEL ELECTRIC LIGHTS RELIGHTED.—The lights in harbor channels in the lower bay were discontinued soon after the declaration of war with Spain. Since Spain's naval fleet has been destroyed, and there is no longer any danger of attack upon the city by Spanish war ships, the electric lights in Gedney Channel have been relighted, and night navigation is permissible.

ELEVATED TRAINS from the Lexington Avenue line (Brooklyn) are now running regularly across the Brooklyn Bridge to Manhattan. They are drawn from the elevated road through the bridge yards to the bridge railway by electric motor cars. In crossing the bridge a trailer on each train picks up the cable. During the middle of the day the cable is stopped and trains are propelled by electric power. Power is utilized only in ascending the grades, being shut off in descending, the trains then "drifting." The Brooklyn Elevated Railroad Company expects to run its Fifth Avenue line trains over the bridge as soon as the rest of the motor cars have been received and prepared for service.

WORK ON THE NEW UNDERGROUND CONDUIT LINES.—President Vreeland, of the Metropolitan Street Railway Company, has notified the storekeepers in Sixth Avenue that as soon as the new tracks are laid in the shopping districts the company will begin to operate horse cars on the line for the convenience of their customers, until the electric cars are put into operation. The construction work has gone on with exceptional rapidity, and two blocks of the Sixth Avenue line, north of Fourteenth Street, have been entirely completed. A section of the work in Eighth Avenue, from Fifty-eighth Street, south, to Fifty-fourth Street, is also finished. The crossing at Sixth Avenue, Broadway and Thirty-fourth Street, has also been finished, considerable of the work at this point having been carried on at night so as to avoid interruption of traffic at this point.

THE FIRST VOLUNTEER REGIMENT OF ENGINEERS, Colonel Eugene Griffin, has embarked on the United States transport "Chester" for Porto Rico, and may sail at any moment for the front. The regiment went aboard of the ship several days ago expecting to sail at once, but one thing and another has prevented the departure of the ship, which at this writing is lying in the bay about a mile off Liberty Island, and the same distance from Governor's Island. The regiment includes several electrical engineers, who were selected by Colonel Griffin. The experience of the regiment since it embarked on the troopship has not been a very pleasant one, however. The weather has been exceedingly hot, and a crowded ship in hot weather is not the most agreeable place on earth. Colonel Griffin, mindful of the comfort of his men, chartered a couple of excursion barges and moored them alongside the "Chester" in order to afford the men an opportunity to "stretch their legs a bit" and get some more air. Idleness on board a stuffy ship at anchor in a placid bay in torrid heat is not a happy state of existence, and the engineers will be glad to get away.

ECONOMY OF THE UNDERGROUND CONDUIT SYSTEM.—The "New York Commercial America," in a recent issue, gives some interesting facts concerning the economy of operation of the underground conduit system. It says that the saving to the Metropolitan Street Railway on its Broadway line by the replacement of its cable system with electricity will reach 1 cent per car mile in the opinion of an authority in the cost of street railway operation. This will be made up in the increased speed possible by the use of electricity over cable power. The two items of importance to be considered, in estimating the cost of operation per car mile on street railways, are speed and weight. In this case there is little, if any, change in weight, but an additional speed of about 25 per cent. should be shown. The Broadway cable line is operated at a speed of only 6 miles per hour. This is less, of course, than on any other line in the country, because of the congestion of traffic. The present cost of the operation of the Broadway cable is 12 cents per car mile. Of this 7 cents is for labor and the balance for power, maintenance, general expenses, etc. The cost will be about the same by the adoption of electricity as a motive power. The advantage, however, arises from the fact that it will be possible for a car to travel 8 miles per hour operated by electricity, while only 6 miles is now made by cable with the same cost for labor. The Metropolitan Company does not publish its figures showing the number of car miles run during any given time, so it is impossible to give the actual saving, but it is evident that it will be an important item.

Buffalo and Niagara Falls Notes.

BUFFALO, N. Y., August 6, 1898

BUFFALO is preparing to extend the new system of electric lighting two more blocks up Main Street. This denotes a radical chainge of ideas on the part of the authorities, for the principal street of the city, from being the worst lighted of its class anywhere, is now about the best, there being a pair of lights at the curb every 100 feet.

THE CONDUIT COMPANY is enlarging the transformer station at the car barns on Niagara Street, in order to make room for special transformers to modify the current to be taken by the Curtis Malting establishment. There will be three 50-kw transformers, of the self-cooling and oil-insulating type, built by the Westinghouse Company, and to be delivered about September 15. They will reduce the current from 2200 to 450 volts.

Chicago Notes.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., August 5, 1898.

MR. MARTIN J. INSULL has withdrawn from the firm of Sargent & Lundy, and has opened an office at 1013 Monadnock Block, as manufacturers' agent. He will continue to handle dynamos, motors, incandescent lamps and other appliances.

MR. THOS. S. GORDON has opened a business as manufacturers' agent at 124 Michigan Avenue, Chicago. He will deal in bare and insulated copper wire for all purposes, copper rail bonds, galvanized telegraph and telephone wire and special wire of all kinds, besides goods in other lines of trade. Mr. Gordon is very popular here, and will no doubt do a large business.

MR. I. J. KUSEL, formerly president of the Missouri Telephone Manufacturing Company, St. Louis, Mo., and later connected with the American Electric Telephone Company, has severed his connection with the American Company, and has cast his lot with the new Victor Telephone Manufacturing Company, Chicago. Mr. Kusel has a host of friends who will wish him success in his new field. It might not be out of place here to state that Mr. Kusel started in the telephone business in its early days with one man in his employ, and in a very short space of time had developed the business to large proportions. He is the patentee of the Kusel microphone. The Victor Company will surely meet with success with live, up-to-date, hustling telephone men in its employ, and it will be the company's constant endeavor to place upon the market only the very finest apparatus, The company's factory is equipped with the very latest and improved machinery, and its facilities are second to none. The new Victor express switchboard, with its removable drops and jacks, is destined to take a place in the front ranks, and the company is doing a good business in the same. In telephones it builds a complete line of both series and bridging telephones; also, cross-connecting boards, lightning arresters, double-pole receivers, magnetos, and a complete line of exchange apparatus.

St. Louis Notes.

ST. LOUIS, Mo., August 5, 1898.

THE BOARD OF TRUSTEES of Winstanley Park have passed an ordinance granting the St. Louis, Belleville & Suburban Electric Street Railway Company a right of way through their city.

TELEPHONE TO KANSAS CITY.—Manager Burt, of the Missouri & Kansas Telephone Company announces that the line between St. Louis and Kansas City will be completed in from thirty to sixty days.

A PETITION has been filed in the St. Louis County Court by the St. Louis & Kirkwood Railroad Company in the form of a motion to amend the court's order of June 11, 1894, by which it granted a franchise to that company to construct and operate a line between the city limits and Meramec Highlands. That order embraced a franchise which they want changed somewhat as to right of way.

THE CENTRAL TRACTION COMPANY will do little in the way of constructing its roads or selling its franchise until the Supreme Court decides on the Julian law. Under the franchise granted the company by the Municipal Assembly the company is compelled to commence work on the construction of its lines before September 1. Pending the action of the Supreme Court, a little work only will be done to comply with the provisions of the ordinance. Last week the directors increased the capital stock from $100,000 to $5,000,000. Over half the stock has already been paid in, and the secretary says that a sale of bonds will follow.

STRIKE.—Between 300 and 400 linemen and outside workers of all the electric lighting and telephone companies in St. Louis went out on a strike last Monday morning. The cause of the strike was the refusal of the managers of the companies to increase their wages from $2.50 to $3 for ten hours' work. Neither side is inclined to yield, and up to the present time the situation is unchanged. Manager Wagner, of the Missouri-Edison Company, says no concessions will be made by his company. Mr. Ross, of the Laclede Gas Company, said his men had made no requests, nothing having been received but a communication from President A. P. Blackford, of Electrical Workers' Union No. 3. The companies seem inclined not to treat with that body as a whole. The strike, up to date, is a peaceful one.

Pacific Coast Notes.

San Francisco, Cal., July 31, 1898.

THE TOWN of Lakeview, Ore., will have telegraphic communication with Bidwell, Cal., in a short time. A bonus of $1000 had to be raised to secure construction of the line.

MR. W. H. BURKHOLDER has returned from Skaguay, Alaska, whither he went last spring for the Westinghouse Electric & Manufacturing Company. While there he installed and set in operation the first electrically driven overhead tramway in Alaska.

ELECTRIC LIGHT AND POWER COMPANIES doing business in Sacramento and Fresno, Cal., have been seriously inconvenienced by the unusually dry season. Drouths severe enough to dry up the rivers and streams, which supply their water power, are of very rare occurrence.

THE SACRAMENTO ELECTRIC COMPANY, which generates power at Folsom, was compelled to shut down its plant about two weeks ago because of the water shortage. Throughout the State there was a light snow and rainfall, causing a drouth more severe than any in recent years.

THE BIG CREEK POWER COMPANY recently closed a contract with the California Powder Works Company, by which the powder works near Santa Cruz will be supplied with 150 horse-power, electrically transmitted. It is probable that the amount of power transmitted will be increased to 450 horse-power later on.

THE GAMEWELL FIRE ALARM TELEGRAPH COMPANY, through Mr. R. A. Rose, Pacific Coast General Agent, recently put in a bid of $38,500 for the apparatus required for the needed extensions of the San Francisco Police Telegraph system. Five central desks, 150 signal boxes, wire, etc., are included.

THE SNOQUALMIE FALLS POWER COMPANY recently decided to let the contracts for the electric machinery, which will be required at the generating station at the falls and at the distributing stations in Seattle and Tacoma, Wash. President Charles H. Baker is now in the Eastern States on business connected with the letting of the contracts, which will probably exceed $250,000. The city of Tacoma, in granting the company a franchise, purposes to stipulate that the company shall be able to supply the city with 3000 horse-power by August, 1899, the rate to be 1¼ cents per kilowatt hour.

Canadian Notes.

Montreal, Que., August 5, 1898.

QUEBEC, QUE.—It has been decided not to extend the electric railway to Montmorency this year, but everything will be in readiness for the change of the system from steam to electricity early next year.

THE ASHCROFT WATER, LIGHT & POWER COMPANY, Ashcroft, B. C., will erect a power house on the Bonaparte River, about three miles from this place, and install an electric light and power plant.

A DEPUTATION of Toronto gentlemen approached the Paris, Ont., Council on the subject of the construction of an electric railroad between that town and Ayr. It is understood that a charter has been applied for.

VICTORIA, B. C.—It is understood that the Consolidated Electric Light Company is preparing to utilize the water power at Goldstream for the electric lighting and railway systems. The work will probably cost $100,000.

A COMPANY is seeking a charter under the name of the Grand River Electric Light & Power Company, to construct a stone dam across the river, with the object of supplying light and power. Mr. Fair, of Brantford, is the company's engineer.

S. C. DRUMMOND, representing the British Electric Traction Company, London, England, has applied to the City Council, Nelson, B. C., for a charter for an electric railway. The Council has signified its willingness to grant application on suitable terms.

AN IMPORTANT CONTRACT has been closed between the Dominion Cotton Company and the Royal Electric Company, of Montreal, whereby the former is to install electricity in its works as motive power. The contract calls for 1500 horse-power from the Chambly works, with the option of increasing it to 3000, the contract to run twenty years.

Ottawa, Ont., August 5, 1898.

THE OTTAWA ELECTRIC COMPANY has supplied its employees whose duty it is to read meters with a portable electric light. The lamp is five-candle power, and will run continuously for twelve hours from the portable storage battery.

IT IS REPORTED that the Ottawa Electric Railway Company is negotiating for the purchase of the Gatineau Valley Railway and will convert that road from steam to an electric railroad. The country through which this line passes is of the grandest in Canada, and it is in the Gatineau Valley that the famous fishing grounds are situated.

TEN MONTHS' earnings of the Montreal Electric Street Railway amount to $1,179,284.63. For the same period last year the earnings of the railway were about $100,000 less. During the month just closed the figures are unprecedented. over $144,000 having been collected and giving an increase of about $15,000 over the corresponding month last year.

MR. NELSON MOORE, of Guelph, Ont., has completed a model of his overhead electric railway. The hardwood posts from which the cars are suspended, as well as the base and the arms, are incased in steel and strongly riveted to prevent vibration. Two iron sockets are suspended from the arms of the post, and into these steel rails are laid. The wheels of the car are built after the manner of bicycle wheels, with steel spokes and ball bearings, which give strength and lightness and ease of motion. The framework of the car will be of strong iron or steel, and the car is suspended from the wheels to a distance of 3 feet from the ground. The interior is fitted with back-to-back seats which run the entire length through the middle and are suspended from the top. The inventor claims many advantages for his overhead road. No grading or groundwork has to be done in constructing the road; no bridges are required to span streams or cross ditches and ravines—a material consideration. Then in the winter time there would be no cleaning away of snow from the track, and, for the same reason, no washouts. Mr. Moore claims that less electric power would be required to operate the cars compared with the present systems; that greater speed would be obtained, and more effective locomotion secured.

General News.

New Incorporations.

CLEVELAND, OHIO.—The Sandusky & Inter-Urban Electric Railway Company has been incorporated, with a capital stock of $500,000. The incorporators are: H. O. E. Everett, E. W. Moore, B. Mahler, C. H. Stewart. Besides operating street railways already existing in Sandusky, Huron, Vermillion, and Cleveland, it will construct and operate an electric line connecting these points.

CHARLESTON, W. VA.—The Rivesville & Montana Telephone Company, of Rivesville, Marion County, with an authorized capital of $50,000, has been chartered to construct and operate telephones from Fairmont to Rivesville, and to Catawba, Montana, Hault, Luther and other points in Marion County. The incorporators are: C. E. Gaskill, J. C. Gaskill, F. B. Clayton, J. S. Koogle, J. D. Arnett, F. F. Prickett, A. S. Prichard, J. S. Cox and J. G. Floyd.

The Telegraph and Telephone.

WESTFIELD, N. Y.—The Westfield Telephone Company has voted to increase its stock from $5500 to $15,000.

CHIPPEWA FALLS, WIS.—The Northwestern Telephone Company, of Shawano, is building a line to Green Bay.

NORTH EAST, PA.—The Mutual Telephone Company and the North East Telephone Company are now working together. There is a lively contest for business between the Mutual and the Bell Companies.

BRIGHTON, MICH.—The new State Telephone Company has decided to build a line from Brighton via Hartland to Fenton. This much-needed improvement will be the first public outlet Hartland has ever enjoyed.

CHESTER, PA.—The Delaware County Telephone Company has about perfected arrangements for extending the line to the Borough of Upland. The work of connecting the two places will be pushed along as rapidly as possible.

COOPER, TEX.—The Southwestern Telephone & Telegraph Company filed suit here to condemn the right of way along the Texas Midland Railroad from Commerce via Cooper to Paris, and the line is expected to be built through by August 15.

NELSONVILLE, OHIO.—The Central Union Telephone Company is making arrangements for the construction of a line which will go from this city to New Lexington. The new line will pass through Murray City, New Straitsville, Shawnee, Corning and intermediate points.

BALTIMORE, MD.—The stockholders of the Interstate Telephone & Telegraph Company elected the following directors: L. A. Carr, J. S. Carr and G. W. Watts, of Durham, N. C.; Dr. P. D. Fahrney and James E. Walter, of Frederick; Robert L. Carr and C. S. Watts, of Baltimore.

BATTLE CREEK, MICH.—The Calhoun County Telephone Company reports that it is now installing the telephones and expects to open the exchange within two weeks. It is said to be putting up a model independent exchange, building it full copper metallic construction and equipping it with the Stromberg-Carlson central energy system.

PROVIDENCE, R. I.—The Providence Telephone Company is building a trunk line from Woonsocket to Pascoag. The route will be from the present Providence line in Oakland to Forestdale, over Nigger Hill to Waterford, thence down River Street, Woonsocket. The line will be metallic circuit and will probably be completed by September 1.

CARLISLE, PA.—The directors of the Cumberland Valley Telephone & Telegraph Company have organized by electing D. K. Appenstellar president; Dr. J. O. Skinner, vice-president; H. B. McNulty, secretary; Dr. David McLay, treasurer. Work will be commenced next month. The line will extend to all points in Franklin and Cumberland Counties.

CHATTANOOGA, TENN.—The East Tennessee Telephone Company has filed a mortgage of $150,000 in the register's office in favor of the Nashville Trust Company, on all of its property in Tennessee and Kentucky. The mortgage has been recorded in every county where the company does business, and it is understood that the money thus secured will be used in extending the long-distance lines and building new lines.

KANSAS CITY, MO.—By September 1 Kansas City will be able to hold conversations with St. Louis, and through that place with Chicago, New York, Boston, Philadelphia and all the large Eastern cities. By that time the Missouri & Kansas Telephone Company expects to have its through wire between

Kansas City and St. Louis in working order. A large force of men is at work on the line, which is completed nearly to Jefferson City.

ROCHELLE, ILL.—The Ogle County Telephone Company intends to extend its lines to all the principal cities and towns in the county at the earliest possible moment. It is now making arrangements to build a line from Rochelle to Davis Junction, connecting Lynnville, Monroe, Kings and Holcomb. As soon as this work is completed, it will continue the line from Davis Junction to Stillman Valley, Byron, Forreston, Polo and Oregon.

SCHENECTADY, N. Y.—The Hudson River Telephone Company has just completed a very important addition to its service. The new line runs from Albany to Thompson's Lake and passes through Delmar, Normansville, Clarksville and East Berne. Another and somewhat longer line is being strung from Albany to Cobleskill. It is distinct from the Thompson's Lake loop and passes through Berne and Gallupville and at Schoharie; a branch runs to Middleburg, the main line continuing through Central Bridge, Howe's Cave and Stone Quarry to Cobleskill.

BOSTON, MASS.—The American Bell Telephone Company's monthly statement of the output of instruments for the month ended July 20 is as follows:

	1898.	1897.	Changes.
Gross output	21,551	15,859	Inc.... 5,692
Returned	10,011	7,241	Inc.... 2,770
Net output	11,540	8,618	Inc.... 2,922
From December 21 to July 20:			
Gross output	187,884	127,778	Inc.... 60,106
Returned	83,306	51,847	Inc.... 31,459
Net output	104,578	75,931	Inc.... 28,647
Total outstanding July 20	1,023,699	848,558	Inc....175,141

GRAND RAPIDS, MICH.—The annual meeting of the members of the Independent Telephone Association of Michigan was held in Grand Rapids, when the following were elected officers: President, J. B. Ware, of Grand Rapids; vice-presidents, W. L. Holmes, of Detroit; C. K. Monroe, of South Haven; George W. Finch, of Escanaba; secretary, Alexander McLeod, of Detroit; treasurer, W. H. Fildew, of St. Johns; executive council, the president, secretary, treasurer, F. B. Johnson, of Lansing; R. F. Johnson, of Saginaw; J. Williams, of Adrian; Hugh Park, of Muskegon; W. C. Osborne, of Kalamazoo; P, H. Parker, of Detroit. The reports presented showed that on the eastern side of the State, the new State company has, during the year, completed toll lines to over 150 towns, and has some 7000 telephones in its system, the Detroit exchange having 5600 telephones in service. The Valley Telephone Company has just begun service in its Saginaw exchange, and has recently completed exchanges in Flint and Bay City, and will have over 2000 telephones in service before September. The Central Telephone Company, of Kalamazoo, has built during the past nine months over 600 miles of toll lines, principally long-distance copper, connecting Grand Rapids with all points on the G. R. & I. Railroad as far south as Sturgis, and on the Michigan Central Railroad from Eaton Rapids to Albion westward through Kalamazoo to Niles and Buchanan and intervening points. It is said the independent companies have some 16,000 telephones in operation, and the Bell Company nearly 14,000.

ELECTRIC LIGHT AND POWER.

PLEASANTON, KAN.—The question of municipal lighting is being agitated.

ALBANY, N. Y.—The passenger coaches on the limited trains on the New York Central & Hudson River Railroad are cooled by electric fans.

HAGERSTOWN, MD.—The Hagerstown Electric Railway Company has purchased a piece of property on Summit Avenue, on which it will erect an electric light plant.

BRATTLEBORO, VT.—Brattleboro people are talking of establishing an electric power plant on West River, six or eight miles from the village, and the extension of the line of the Brattleboro Street Railway Company.

KOKOMO, IND.—By the explosion of a boiler at the power house of the Citizens' Electric Light Company the plant was badly wrecked on the night of July 28, leaving the town in darkness. George Dunning, the engineer, was instantly killed.

WESTERVILLE, OHIO.—A private plant is to be installed here immediately with a 40-kw, 220-volt dynamo and a 60-hp engine. Mr. E. T. Aldrich, No. 11 Wesley Block, Columbus, Ohio, will be glad to receive estimates on material for the same.

MINERAL POINT, OHIO.—Sealed proposals will be received August 22 for the construction of an electric light and water works plant in Mineral Point City, Tuscarawas County. Specifications can be had on application to T. H. Edwards, clerk.

SALT LAKE CITY, UTAH.—The Dexter Company has about completed necessary preliminary arrangements for the construction of the new electric power line and plant for the operation of its forty-stamp mill at Tuscarora, Nev. When completed the works will give more than the required power for the running of the mill and the company will have power to sell.

FRESNO, CAL.—Fresno was in darkness one night recently because of a lack of water in the north fork of the San Joaquin River to generate power sufficient to run the plant of the electric company to its full capacity. The water is not sufficient for the company to supply its patrons with the usual service, which amounts to from 800 to 1000 horse-power. There is a great shortage of water in the mountains, as many of the streams have dried up. The snow has disappeared and the springs have quit running. The north fork of the San Joaquin, where the power plant is located, is low, and the big reservoir, some 25 miles further back in the hills, affords but little water.

DETROIT, MICH.—The Edison Illuminating Company, of this city, has prepared plans for the rebuilding of its station, at the corner of Washington Avenue and State Street. The present building, which is partly two stories high, will be raised to the uniform height of four stories and be made strictly fireproof. The building will be of steel frame construction, having a frontage of 70 feet on Washington Avenue and 40 feet on State Street. There will be two fast-running elevators—one each for passengers and freight. The building will be equipped with the most approved modern electrical machinery, the intention of the owners being to make it one of the best plants of the kind in the United States. Work will commence at once.

THE ELECTRIC RAILWAY.

CONCORD, N. H.—The street railway company is to install a generator in the power house immediately for the purpose of lighting the park independently of the power circuit.

CINCINNATI, OHIO.—Receiver Cone sold the Delaware (Ohio) Street Railway on July 30 at public outcry to B. W. Brown and others, of Delaware, for $13,525. The road originally cost $40,000.

NORWICH, N. Y.—It is now asserted that the Sidney-Franklin Electric road will be built if $20,000 is guaranteed by local capitalists, the money not to be paid until the completion of the road.

FALL RIVER, MASS.—The railroad commissioners have authorized the Providence & Taunton Street Railway Company to increase capital by $15,000 to $75,000 and to issue $175,000 first mortgage 5 per cent. bonds for construction.

LOUISVILLE, KY.—The Richmond, Nicholasville, Irvine & Beattyville Railroad, which is in the hands of John MacLeod as receiver, will be put up for sale for the second time on September 6, through the failure of Adolph Segat, of Philadelphia, to make his purchase good by July 23. The upset price will again be $160,000.

NEW YORK, N. Y.—It is reported that leading interests in the Pennsylvania Railroad Company have become large stockholders in a number of the trolley companies in cities and towns through which the Pennsylvania runs. This is thought to be preliminary to a possible control of the trolley lines for the sake of the steam roads.

NILES, MICH.—The Michigan & Indiana Electric Railroad Company has filed articles of association with the Secretary of State and will build an electric railroad from South Bend, Ind., to St. Joe, Mich., connecting with Niles and other Berrien County towns. Work will begin next spring, and power will be derived from a dam at Berrien Springs.

PITTSBURG, PA.—The Pittsburg & West End Traction Company has just completed the installation of two 1000-hp engines, connected with Westinghouse generators, in its new power house on West Carson Street. The company is now making extensions to Robinson Park, on Mt. Washington, and to Bridgeville. It will soon connect with the Neville Island line at Island Avenue, McKee's Rocks.

ALBANY, N. Y.—A certificate of an increase of the capital stock of the Nassau Railroad Company, of Brooklyn, from $6,000,000 to $15,000,000 was filed with the Secretary of State, the increase having been approved by the State Railroad Commission. The increase is to be expended in pay for road extensions and improvements already made and to be made, and to retire the bonds of leased roads.

NEW YORK, N. Y.—Negotiations are in progress between representatives of the Brooklyn Rapid Transit and the Nassau Electric Companies which look to a merger of the two properties on a basis which will give to the Brooklyn Rapid Transit a complete monopoly of surface street railway business in and about Brooklyn. It is intimated that a consolidation agreement is close to execution, though insiders decline to discuss the matter.

CHESTER, PA.—It is stated that the Media, Middletown & Aston Trolley Company is about to pass into the hands of a Philadelphia syndicate. Ex-Congressman John B. Robinson, who is president of the company, with the others interested, has endeavored for several years to bring about the consummation of the connection of the city of Chester with Village Green, Rockdale and other thriving places in Aston and Middletown townships.

JEANNETTE, PA.—Extensive improvements are under consideration by the new owners of the Greensburg, Jeannette & Pittsburg Electric Street Railway. It is understood that the Hempfield & Greensburg branch, running from Greensburg to Huff Station, will be widened to the standard gauge and continued on to Mt. Pleasant. The road, which now terminates at Manor Station, will be pushed on to Wilmerding, where it will connect with the Second Avenue line, and by this route enter Pittsburg.

NEW YORK, N. Y.—There is a proposition under consideration by the Brooklyn Heights Railroad Company for the refunding of the bonding indebtedness of the Brooklyn, Queens County & Suburban Railroad. The company has $3,500,000 first mortgage 5 per cent. gold bonds outstanding, due in 1916, and $4,500,000 first consolidated bonds due the same year, and $240,000 first mortgage bonds due in 1930. If the interest on these issues could be reduced from 5 per cent. to 4 per cent. there would be an annual saving of $65,000 to $80,000.

ALBANY, N. Y.—The State Railway Commissioners on August 3 granted an application to the Third Avenue Railway Company, of New York City, for permission to change its motive power to the underground conduit system on all its lines now operated by cable. The board declined to pass on the application for the use of compressed air motors and storage battery cars, in addition to the underground conduit system. It is stated that when the company is ready to use either of these methods of propulsion it may apply to the board for approval in each case.

BLOCK ISLAND, R. I.—The event of this summer at this remote spot in the sea is the opening of a horse-car line. The natives of the island look upon the innovation with much favor, and use the same expressions in hailing the cars that they use at sea in their boats. The common form of hail is said to be "Avast there," or "Heave to," and to bring the car to a stop in order to get off some such command as "Haul down your jib, and let go your anchor, till I get off," is likely to be applied to the situation. The native islanders are enthusiastic over what is to them a modern improvement. If the horse cars pay this season electric power will probably be installed next year.

NEW YORK, N. Y.—The third order for iron trolley poles has just been received by a firm in this city from Liverpool. The first order, about two months ago, called for 200 poles, the second for 300 and the one received by last mail called for 500. At an average price of $15 apiece, the value of these

poles is $15,000. The larger the order the cheaper they may be bought. Yet about three months ago an order for 20,000 poles for the Japanese market was not placed in the local market on account of the British price being from 10 to 15 per cent. cheaper than the American. The local shippers to Liverpool are at a loss to understand, under the circumstances, why their firm in Liverpool keep sending orders for poles over here.

NEWPORT, R. I.—It is not very long ago since an indignation meeting was held in this city by the prominent wealthy summer residents of this famous watering place to express their disgust and abhorrence at the suggestion of introducing a trolley road in this city. The meeting was presided over by Mr. William Waldorf Astor, and "Society" almost went into a fit over the mere thought of an electric railway invading the sacred precincts of Newport. But the idea would not down. It grew, and it grew; and finally the electric railway came, and people here are now wondering how they ever got along without it. But curious changes have been wrought by the innovation. Those who most bitterly opposed the introduction of the electric railway here are now its most prominent supporters, and trolley parties among the "upper ten" is the coming fad. Mr. and Mrs. O. H. P. Belmont gave a trolley party on the evening of August 2. Now the pace has been set in this direction these select trolley parties will unquestionably become very fashionable.

Legal Notes.

THE ILLINOIS SUPREME COURT has handed down a decision which will result in curtailing the powers of the street railways in condemning private property. The court holds that the street railway companies have not the same rights as steam railroads in condemning land for track routes. The street railways must stick to the highways and streets, except where this is absolutely impracticable. It was held by the street railway companies that the Allen law allowed them to select any route and to condemn property wherever they saw fit. When the Aurora & Geneva Railroad Company started in to lay a road bed over the private property along the Fox River to Batavia, the owners made a protest. One of them, Jennie D. Harvey, brought suit to restrain the company. She was defeated in the lower courts, but has just won a decisive victory in the Supreme Court.

DEFEAT FOR THE BELL COMPANY IN WASHINGTON.—A press dispatch from Washington on August 4 announces that Judge Hagner, in the District of Columbia Supreme Court, rendered a decision against the Chesapeake & Potomac Telephone Company, and granted an order restraining it from removing instrments from the premises of subscribers who refuse to pay more than $50 per year rental. The last Congress enacted a law limiting the charges to $50 per year for each instrument in the District of Columbia. Subscribers in Washington refused to pay more, and the telephone company attempted to remove the instruments. James F. Manning & Co. commenced legal proceedings to restrain the telephone company from such action. The latter alleged that the act referred only to Government service, and that as otherwise applied it was unconstitutional. Judge Hagner overruled all of the company's objections and granted a temporary restraining order.

Personal Notes.

MR. EDWARD WESSELS, formerly managing director of the Standard Air Brake Company, and the owner of the illustrated weekly newspaper, "The Universe," has just purchased all right, title and interest in "Sunbeams Magazine," which has been in existence seven years. Mr. Wessels will merge "Sunbeams" into "The Universe," and the publication offices will be at 150 Fifth Avenue, New York City. "The Universe" has rapidly worked its way into favor, and it now goes to all parts of the world.

MAJOR J. O. KERBEY, who has recently returned from a trip to Brazil and other South American countries in the interest of the development of the rubber industry, is now at Wilmore, Pa. Major Kerbey is concerned in a projected electric railroad in Amazonia, and desires to arrange with an electrical engineer to visit Amazonia and go over the line of the proposed road for the purpose of obtaining data and other information to determine the feasibility and practicability of such a line. Major Kerbey is deeply interested in the subject of india rubber, and claims to have discovered the existence of gutta percha in South America.

Trade and Industrial Notes.

DR. L. K. BOHM has moved his office from 115 Nassau Street to 320 Broadway, New York City, where he will continue his business as solicitor of American and foreign patents, trade marks, etc.

THE CENTRAL ELECTRIC COMPANY, Chicago, is issuing a very attractive circular on various types of electrically heated cooking utensils and appliances, and will be pleased to send a copy of the same to anyone on application.

THE FORT WAYNE LAMP COMPANY, Cleveland, Ohio, desires to notify the trade that N. S. Parker, who is reported to be traveling through the West representing himself as an agent of that company, is not a representative of that concern.

THE "PETITE" INCLOSED LONG-BURNING ARC LAMP.—The Western Electric Company, Chicago, in placing upon the market its new long-burning arc lamp, used the name "Midget" in describing it, owing to its size, the lamp being about 20 inches in length. The name "Midget," however, is no longer used, but the name "W. E. Petite" has been adopted.

MESSRS. FELIX SINGER & CO., manufacturers of electrical machinery, Berlin, Germany, have recently received a contract from the Società Romana Tramways Omnibus at Rome, Italy, for the electrical equipment of thirty motor cars. Each car will be fitted with two Walker motors. A number of competitive tests of electrical equipment has been made for some time. The Walker apparatus was selected on account of its general excellence.

THE CUTLER-HAMMER MANUFACTURING COMPANY, Chicago, reports that its business has increased so rapidly in the past few months that it has been obliged to secure additional space, which it is equipping with the latest improved machinery. With these additional facilities the company expects to be able to take care of all orders in a prompt and efficient manner.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Chicago, is announcing a divided circuit toll line telephone system that is claimed to be entirely free from the broad claims of the Carty patent on the bridging system, recently upheld in Pennsylvania as valid. It is said to have some new and improved feature, compared with the regular bridging or series systems.

THE WESTINGHOUSE MACHINE COMPANY, Pittsburg, Pa., has already begun to reap some benefit from the recent brilliant successes of American arms in Cuba. Its New York office has received the initial order for a complete steam plant, including a 100-hp Westinghouse engine and Westinghouse generator, together with boiler, pump, piping, etc. This plant to be installed in Santiago de Cuba.

PATTISON, GOTTFRIED & HUNTER, 146-150 Centre Street, New York City, have just gotten out an interesting and complete illustrated catalogue of machine tools, lathes, shapers and stamp presses of special interest to manufacturers of electrical specialties. Their universal hand milling machine is especially adapted for use in electrical repair shops and in shops connected with nearly every large central station. A copy of the catalogue will be sent to anyone interested on application to the firm.

"TRIPS BY TROLLEY AND AWHEEL AROUND HARTFORD" is the title of an attractive little booklet just issued by Elmer M. White and Herbert O. Warner, Hartford, Conn. Various trolley trips about the city of Hartford, New Britain and other places in that section of the country are described and excellently illustrated with half-tone cuts. Some very artistic taste is displayed in the selection of the views. Judging from the illustration the towns and country about the neighborhood of Hartford are extremely attractive.

THE SHOPS of the Walker Company, Cleveland, Ohio, are running night and day on existing orders, and the recent large additions to the plant, it is stated, will be taxed to the utmost to produce the immense amount of work now in hand. Prof. S. H. Short recently secured a duplicate order for alternating apparatus from the Union Carbide Company, Chicago. The order, as it now stands, comprises over 20,000 horse-power in generators, and forms what is stated to be the largest contract for electric machinery of any kind ever awarded.

THE ALLGEMEINE ELEKTRICITATS-GESELLSCHAFT, Berlin, Germany, has published a list of electric railways installed by it in many of the principal European cities and a list of roads in process of construction. The list also includes various projected roads. The total length of the lines completed and under construction is 1095 kilometres; number of motor cars, 1861. The system of this company is installed on all of the roads referred to. The list gives considerable data in tabular form concerning the roads, and will be valuable to electrical engineers for reference.

HOISTING PLANTS.—The Denver Engineering Works, Denver, Col., in its catalogue No. 6, just issued, describes and illustrates electric and steam hoists made by that concern. The standard electric mining hoist is operated by a railway-type motor and controller. The drum, motor and controller are mounted on one bed plate. With slight changes the motors can be adapted to present hoists. A table shows that the standard hoist is made in nine sizes, based on hoisting capacity. The sizes of motors used range from 7 to 100 horse-power, and the hoisting capacities from 1200 pounds at 150 feet per minute to 5000 pounds at 500 feet per minute.

THE AMERICAN ELECTRIC TELEPHONE COMPANY, Chicago, writes to say that the recent decision in Pittsburg on the bridging bell patent has no bearing on the bridging telephones manufactured by it. It claims that its system is about the only non-infringing multiple system in existence. The reason for this is that its bells are not wired as shown in the Carty patent. The ringers are wound to suit the requirements of the different lengths of line and the ringer magnets are not permanently "bridged" on the line, being disconnected from it when the telephones are in use, and re-connected with it automatically when conversation is discontinued.

MONTAUK MULTIPHASE CABLE has been successively introduced in Australia. Mr. E. H. Kirkby, an electrical engineer of Williamstown, which is the port of Melbourne, in July last gave a practical test of the application of the cable for fire alarm purposes before a company of prominent citizens. The demonstration produced a marked impression. Mr. Kirkby is convinced that if this cable had been used in Melbourne the recent great fire there might have been averted. The Montauk Multiphase Cable Company, New York, is proud of the fact that its cable has made its mark at the Antipodes, and this without any direct influence from the home office. The results prove the well-known fact that a meritorious article is soon recognized.

THE NEW WORKS of the Warren-Medbery Company, Sandy Hill, N. Y., are now running to their utmost capacity, day and night, in order to fill the orders for the company's apparatus. It is reported that business has increased over 100 per cent. within the last sixty days, the demand for inductor machines reaching far beyond the company's utmost expectations. The company has recently made a large addition to its works, and the new machinery is now being installed. It is manufacturing a full line of standard white marble switchboards, and a full line of "Medbery" and "Standard" switches. The "Medbery" insulation and overhead equipment, for electric railways, is now being manufactured by this company, which is prepared to furnish this high-grade material promptly.

METROPOLITAN INJECTORS.—The Hayden & Derby Manufacturing Company, No. 111 Liberty Street, New York, has just issued its 1898 catalogue of Metropolitan injectors and H. D. ejectors. Several new features have been introduced in its make-up. In the ratings of injectors the horse-power is given not only on the basis of 7½ gallons of water per horse-power per hour, which has always been the standard basis of figuring the horse-power of injectors, but the horse-power on a basis of 30 pounds' evaporation of water per horse-power per hour is also given. Injectors with flanged as well as screwed connections are shown for the first time, and all the various forms of injectors manufactured by this company are shown in dimension diagrams, which enables the piping to be laid out from the data thus given. The catalogue also describes new forms of ejectors, hot water heaters and special injector fittings.

ELECTRICITY FOR MACHINE DRIVING.—The Westinghouse Electric & Manufacturing Company, Pittsburg, Pa., has just issued a very handsomely illustrated brochure under the title above named. The object of the company in producing this work is to point out a few of the many advantages to be secured by the use of electric current, instead of long lines of shafting and connecting belts, for the transmission of power. The advantages as enumerated and discussed are: Reliability, convenience and flexibility, saving of power, sanitary improvement, increased output, decreased cost of maintenance, and concentration of generating units. The illustrations are artistically executed and include one of a rotary planer driven by a Tesla polyphase motor; a 1000-hp two-phase generator direct-connected to a Pelton water wheel, and an electric 30-ton crane operated by 500-volt direct-current motors.

THE CLONBROCK STEAM BOILER COMPANY, Brooklyn, N. Y., has just issued a very handsome catalogue on the Morrin "Climax" vertical water tube boiler. A very complete description of this well-known boiler is given, and its advantages pointed out. The catalogue contains, besides, a large number of excellent half-tone illustrations, a large number of testimonial letters from different concerns using the Clonbrock boiler in their steam generating plants, and reports of various tests of Clonbrock boilers, showing excellent results. At the back of the book considerable engineering information and data are given which will be found very valuable for reference. Among the illustrations are shown views of the Climax boiler plants at the World's Fair, and the Tennessee Centennial Exposition at Nashville, and various other plants in operation and in course of construction. The Climax boiler is made in sizes from 50 to 1000 horse-power.

Directory of Scientific Societies, Associations, Etc., and Meetings of the Same

CHICAGO ELECTRICAL ASSOCIATION.—Meetings, third Friday of each month; J. R. Cravath, secretary.

THE NEW YORK ELECTRICAL SOCIETY.—President, Gano S. Dunn; secretary, George H. Guy, New York.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA., Pittsburg, Pa.—Meetings, third Tuesday of each month.

CANADIAN ELECTRICAL ASSOCIATION.—President, William H. Browne, Montreal; secretary, C. H. Mortimer, Toronto, Ont.

FRANKLIN INSTITUTE (Electrical Section), Philadelphia, Pa.—Secretary, William H. Wahl.

MASACHUSETTS CHARITABLE MECHANIC ASSOCIATION, Boston, Mass.—Exhibition of Motor Carriages, October 10 to December 3, 1898.

NORTHWESTERN ELECTRICAL ASSOCIATION.—President, F. A. Copeland, La Crosse, Wis.; secretary, Thomas R. Mercein, Milwaukee, Wis.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—F. W. Putnam, secretary, Salem, Mass. Next meeting, Boston, Mass., August 22-27, 1898.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, New York.—President, Dr. A. E. Kennelly; secretary, Ralph W. Pope. Meeting, third Wednesday of each month.

NATIONAL ELECTRIC LIGHT ASSOCIATION.—President, A. M. Young, Waterbury, Conn; secretary, George F. Porter, New York. Next meeting, New York, May or June, 1899.

AMERICAN STREET RAILWAY ASSOCIATION.—President, A. E. Lang, Toledo, Ohio; secretary, T. C. Penington, Chicago, Ill. Next meeting, Boston, Mass., September 6, 7, 8 and 9, 1898.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS.—President, W. W. Ryder, Chicago; secretary, P. W. Drew, Milwaukee, Wis. Next meeting, Wilmington, N. C., June 19, 1899.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK.—President G. Tracy Rogers, Binghamton, N. Y. Next meeting, Hotel St. George, Brooklyn, N. Y., September 13 and 14, 1898.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES.—President, Samuel Insull, Chicago; secretary, Wilson S. Howell, Harrison, N. J. Next meeting, Sault Ste. Marie, Mich., September 12 and 13, 1898.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION.—Dr. C. R. Dickson, Toronto, Can., president; Dr. John Gerin, Auburn, N. Y., secretary. Next meeting, Buffalo, N. Y., September 13, 14 and 15, 1898.

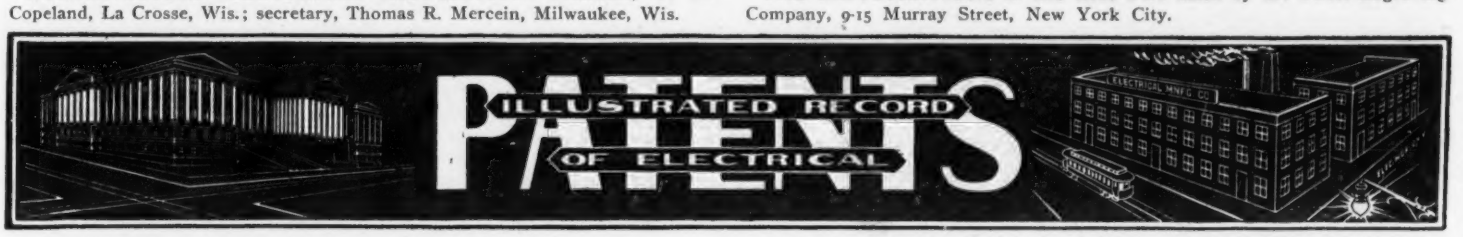
THE OHIO ELECTRIC LIGHT ASSOCIATION.—President H. K. Wood, Piqua; vice-president, Emil C. Schmidt, Sandusky; secretary and treasurer, Samuel Scovil, Cleveland. Next meeting, Sandusky, Ohio, August 18 and 19, 1898.

ASSOCIATION OF FIRE AND POLICE TELEGRAPH SUPERINTENDENTS AND MUNICIPAL ELECTRICIANS.—President, Will Y. Ellett, Elmira, N. Y. Next meeting Hotel Langewell, Elmira, N. Y., August 9 and 10, 1898.

INDEPENDENT TELEPHONE ASSOCIATION OF THE UNITED STATES.—President, Judge James M. Thomas, Chillicothe, Ohio; secretary, W. J. Vesey, Fort Wayne, Ind. Next meeting, June, 1899. Place to be named hereafter.

Business Notice.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 9-15 Murray Street, New York City.



UNITED STATES PATENTS ISSUED AUGUST 2, 1898.
[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

608,175. RECIPROCATING ELECTRIC DRILL; H. Casler, of Canastota, N. Y. App. filed March 18, 1898. In a reciprocating drill, the combination with energizing coils and a magnetic core within the same, of a casing for the coils composed of an exterior shell, heads or ends and an interior lining tube all of iron or steel, and united by water-tight joints.

608,178. ELECTRICAL RAIL BOND AND METHOD OF SECURING SAME IN PLACE; W. R. Cock, of Plainfield, N. J. App. filed Dec. 7, 1897. The method of securing a hollow, preferably slightly conical, electric bond terminal in place in a rail, which consists, first, in forcing the terminal into a perforation in the rail and then expanding it and clenching it against the edge of the perforation in the rail by progressively expanding the hollow bond terminal by means contacting and acting at one time only on a narrow annular section of the bond terminal, but successively on all portions of the bond to be expanded.

608,211. SYSTEM FOR HEATING BY ELECTRICITY; Jas. F. McElroy, of Albany, N. Y. App. filed Nov. 16, 1892. In an electric-heating system, the combination and arrangement of a plurality of heaters, consisting respectively of a plurality of heating sections, with single heaters, consisting of but one heating section, so connected that the single heaters may be placed in either circuit in which the heating sections in the heaters containing a plurality of heating sections may be placed, with means for varying the connections.

608,216. BATTERY-ZINC; Dora Ogden, of Columbus, Ind. App. filed April 12, 1897. The combination of a battery cell, having a cover provided with an opening therethrough for the introduction of the electrodes, two or more electrodes with stems, and means for securing said stems within said opening, whereby the said electrodes may be suspended within the cell.

608,228. GALVANIC BATH; C. E. Schnee, of Carlsbad, Austria-Hungary. App. filed Sept. 14, 1897. A galvanic bathing apparatus composed of upper and lower tubs, insulating bases for supporting the same, a pair of electrodes projecting into each of the tubs, wires connecting the upper tubs and leading to the negative pole, and wires connecting the lower tubs and leading to the positive pole of a source of electric energy.

608,234. INSULATING CASTER AND ELECTRIC SWITCH COMBINED; A. W. Slayton, of Tecumseh, Mich. App. filed May 18, 1898. An insulating caster, the wheel of which is made of glass combined with a metallic contact arm pivotally secured to the metallic frame or support of the caster and adapted to form an electric connection with the floor.

608,246. ELECTRICAL SIGNALING APPARATUS FOR TRANSMITTING COMMANDS; C. Arldt, of Berlin, Germany. App. filed Dec. 29, 1897. In an electrically actuated signaling apparatus, the combination of a transmitting instrument comprising a closed wire coil, two diametrically opposite rotatable contacts supplying current thereto, three leads connected to the coil at points 120° apart and a receiver consisting of three coils connected to the leads and acting upon a central rotatable magnet, having a pointer whereby variation of resistance in the transmitter caused by the change of position of its rotatable contacts will effect the movement of the pointer in the receiver to the corresponding position quite independent of any variations in the tension of the current supplied.

608,249. ALTERNATING-CURRENT INDUCTION MOTOR; C. S. Bradley, of Avon, N. Y. App. filed Oct. 22, 1895. An alternating-current motor provided with two armatures of relatively high and low resistance, and independent field magnets wound to develop rotary magnetic fields of different densities co-operating therewith.

608,258. ELECTRIC BOND FOR RAILWAY RAILS; S. H. Harrington, of New York. App. filed Dec. 10, 1896. In an electric bond for railway rails, the combination of an iron or steel rail, having a perforation performed in its web at an acute angle to the plane of the web with a bond ferrule formed of metal having greater conductivity than the metal of the rail, said bond ferrule being inserted in and brought into close contact with the sides of the perforation in the rail web, and a bond body also formed of metal of greater conductivity than that of the rail, said bond body being inserted in the ferrule.

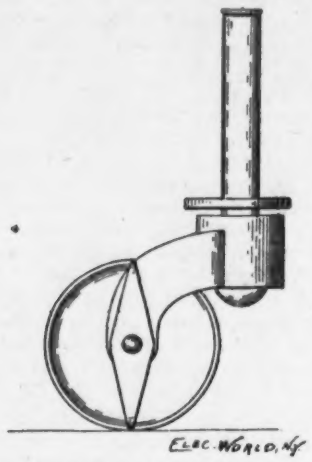
608,269. ELECTRIC ARC LAMP; C. A. Pfluger, of Chicago, Ill. App. filed Aug. 7, 1895. In an arc-lamp hanger, the combination of a fixed box or case with current-controlling devices therein, tubes downwardly projecting therefrom and carrying each one conductor, and means associated with such fixed box and adapted to engage the carbon-rod tube of the lamp, so as to hold such lamp in position.

608,277. ARMATURE FOR DYNAMO-ELECTRIC MACHINES; E. H. Anderson and D. P. Thompson, of Schenectady, N. Y. App. filed Jan. 8, 1898. In a dynamo-electric machine, the combination of a field magnet, an armature, a toothed core therefor separated from the field magnet by an air gap, and air gaps in the armature core arranged to divide the field flux into two parts.

608,281. TROLLEY; F. E. Case, of Schenectady, N. Y. App. filed June 30, 1897. In a trolley, the combination of a base, a combined lifting and buffer

spring extending in one direction only from the base, and a pole socket pivoted to the base at a point below the centre line of the spring.

608,299. COMMUTATOR; W. B. Potter, of Schenectady, N. Y. App. filed April 27, 1898. In a commutator, the combination of a plurality of segments



No. 608,234.—Insulating Caster and Electric Switch Combined.

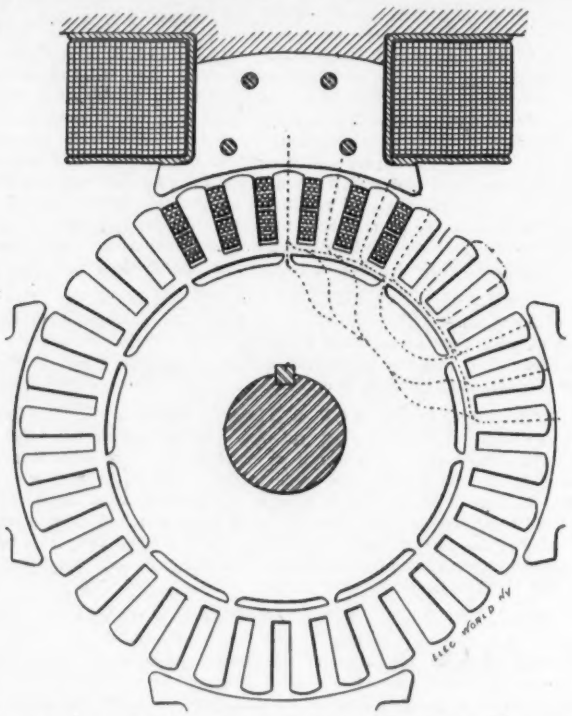
separated from each other by a layer of insulating material, each segment having substantially a slot straight across the outer or face side, and provided with an armature-lead slot and a lug for securing it to a support, and a circumferential groove into which the lead slots extend at a point below the wearing surface of the commutator.

608,301. SYSTEM OF TRAIN CONTROL; E. W. Rice, Jr., of Schenectady, N. Y. App. filed Dec. 31, 1897. The combination of motor cars at different positions of a train, a single conductor connecting said cars, and a switch on one of the motor cars for coupling the motor equipment of the different cars in series or parallel.

608,302. SYSTEM OF TRAIN CONTROL; E. W. Rice, Jr., of Schenectady, N. Y. App. filed March 26, 1898. In a system of electric-motor control, the combination of a controller for regulating the motor, and means actuated by the motor when acting as a generator for moving the controller to a predetermined position.

608,307. ELECTRICAL DISTRIBUTION; C. P. Steinmetz, of Schenectady, N. Y. App. filed July 14, 1894. The herein-described method of obtaining three-phase currents, which consists in connecting in series three single-phase alternating generators, and deriving three-phase currents from mains taken from points between said generators.

608,308. SYSTEM OF ELECTRICAL DISTRIBUTION; C. P. Steinmetz, of Schenectady, N. Y. App. filed July 14, 1894. The combination with a



No. 608,277.—Armature for Dynamo Electric Machines.

source of alternating electromotive force, of mains leading therefrom to a distant point, a plurality of sources of dephased alternating electromotive force in series across the mains, and connections from the junctions to a multiphase translating device.

608,309. REGULATING DYNAMO-ELECTRIC MACHINES; C. P. Steinmetz, of Schenectady, N. Y. App. filed April 23, 1898. The method of securing a straight compounding curve in a dynamo-electric machine which consists in operatively introducing an air gap into the magnetic circuit at a predetermined flux.

608,319. ELECTRO-MECHANICAL CLOCK; H. G. Carleton, of New York, N. Y. App. filed Sept. 9, 1897. The combination with a door lock and an electric circuit for operating the same, of a hand-operated combination mechanism in said circuit comprising a rotative disc, provided with means for indicating the position of the combination mechanism, an indicating finger piece on the outer side of the door yieldingly coacting with said disc, and a circuit closer hand-operated from the outer side of the door.

608,321. ELECTRIC LOCK; H. G. Carleton, of New York, N. Y. App. filed May 24, 1898. In an electrically controlled lock, the combination with a movable magnet, and its armature, of one of the engaging parts of the lock, such as the latch or keeper, the parts being so constructed and arranged that when the magnet attracts the armature the magnet armature and the engaging parts will move together.

608,333. TELEGRAPHIC TRANSMITTING AND RECEIVING APPARATUS; B. Hoffmann, of Paris, France. App. filed May 5, 1897. In a printing-telegraph instrument, the type wheel of which carries a double series of characters disposed in alternate order around its periphery, and capable of displacement upon its spindle to an extent equal to half the advance of the spindle at each movement, mechanism for shifting and locking the type wheel, consisting of the combination with the type wheel and spindle of two spring catches adapted to lock the type wheel and spindle together, in their respective positions, inclines carried on the type wheel in two positions corresponding to shifting blanks or spaces, and the printing lever having a bevel adapted in either of said positions to disengage the spring latch, thereby unlocking the type wheel, and having a nose adapted thereupon to engage the inclines upon the type wheel and turn the latter to its other position, whereupon the other spring catch engages and again locks the type wheel and spindle together.

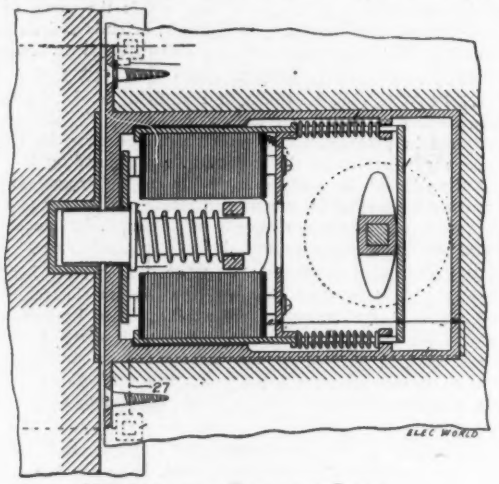
608,340. AUTOMATIC SWITCH FOR REGULATING ELECTRIC AIR COMPRESSORS; M. Moseley and P. Funck, of Rochester, N. Y. App. filed Nov. 15, 1897. The combination with an electric motor and compression pump of the automatic switch for controlling the motor circuit, consisting of two communicating cylinders provided with pistons, suitable insulated contacts, one of which is movable, and operated by the movement of one piston produced by the admission of air to its cylinder by the movement of the other piston.

608,343. ELECTRIC HEATER; J. F. McElroy, of Albany, N. Y. App. filed April 6, 1895. In an electric heater, the combination of a central core piece carrying radial arms at either end, and encircling spring placed about encircling springs and extending longitudinally parallel with the core piece, a resistance wound upon said insulating bars and straining the encircling springs against the tension of the wire.

608,389. RAPID TELEGRAPHIC TRANSMISSION ON CABLE LINES; C. Langdon Davies, of London, England. App. filed June 25, 1896. The combination with a key and a source of electromotive force for transmitting telegraphic signals over a line or cable circuit, of an electromagnet actuated following the closing of the key to disconnect the line from the source of the electromotive force before the current from said source has risen in the line to its effective maximum.

608,412. JOINT FOR ELECTRIC CONDUCTORS; H. S. Patten, of Montclair, and Wm. Maver, of Jersey City, N. J. App. filed Dec. 31, 1897. The combination with the conductors and their insulating coverings, of couplings to which the ends of the conductors are soldered or otherwise permanently connected, such couplings having lapping ends with closely fitting surfaces, and a clamping device for holding them together.

608,497. ELECTRIC HEADLIGHT LAMP; H. P. Wellman, of Ashland, Ky. App. filed Dec. 10, 1897. In an electric lamp having upper and lower



No. 608,321.—Electric Lock.

carbon rods, brackets supporting said rods, one of said brackets having an electric terminal, and overhanging ears, an insulating disc with which one of said rods engages having an arm for contacting with said terminal, and also arms for engaging said ears.

608,504. TELEPHONE-TRANSMITTER ARM AND ITS ATTACHMENT; W. J. Barr, of Ashtabula, Ohio. App. filed Oct. 30, 1897. The combination, with the base having a mouth and trunnions,, the transmitter arm and a bearing cap, of a spring secured between said cap and arm, and bearing on the trunnions.

608,537. BATTERY ELECTRODE; H. W. Wilkinson, of Mount Vernon, Ohio. App. filed June 10, 1897. A grid having pockets formed in plate sections, said sections being secured side by side vertically to a supporting plate.